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The Ecology & Management of Oregon Coast Range Forests:

A mid-term COPE symposium
March 29-31, 1994
Salishan Lodge
Gleneden Beach, Oregon

Coastal **O**regon **P**roductivity **E**nhancement

The Ecology & Management of Oregon Coast Range Forests

March 29-31, 1994 ❖ Salishan Lodge ❖ Gleneden Beach, Oregon

Day One March 29

Opening
7:00 am Registration begins
7:55-8:00 Welcome
8:00-8:20 Keynote Address

Riparian Zone Ecology & Management: Terrestrial Riparian Ecology
8:20-10:00

10:00-10:30 Break

Aquatic Ecology
10:30-12:00

12:00-1:30 Lunch

Trends in Aquatic Communities in Coast Range Streams
1:30-3:00

3:00-3:30 Break

Terrestrial Systems
3:30-5:00

5:30-7:30 Poster Session and Dinner

Day Two March 30

Stream Ecosystem Restoration
8:00-8:45

Upslope Ecology and Management: Silviculture and Plant Ecology
8:45-10:30

10:30-11:00 Break

Wildlife
11:00-12:30

12:30-1:50 Lunch

Landscape & Community Perspectives
1:50-3:05

3:05-3:30 break

Perspectives and Directions for the Management of Oregon Coast Range Forests - a Panel Discussion

3:30-5:15

Day Three March 31

Optional Field Trip
8:00-5:00

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The Ecology & Management of Oregon Coast Range Forests

March 29-31, 1994 ❖ *Salishan Lodge* ❖ *Gleneden Beach, Oregon*

Day One

Opening

7:00 am	*Registration begins*
7:55-8:00	*Welcome:* John P. Hayes
8:00-8:20	*Keynote Address:* George Brown

Riparian Zone Ecology & Management

Terrestrial Riparian Ecology

Moderator: Michael Adam

8:20-8:50	*Structure, Composition, and Productivity of Riparian Vegetation in the Oregon Coast Range* Thomas A. Spies, Robert Pabst, John Tappeiner, & Nathan Poage
8:50-9:05	*Streamside Versus Upslope Breeding Bird Communities in the Central Oregon Coast Range* Kevin McGarigal & William C. McComb
9:05-9:20	*Small Mammals & Amphibians in Coast Range Riparian Ecosystems* Douglas M. Gomez & Robert G. Anthony
9:20-9:35	*Research on Bat Populations in Riparian Areas of the Oregon Coast Range* John Hayes & Pat Hounihan
9:35-10:00	*Discussion*
10:00-10:30	*Break*

Aquatic Ecology

Moderator: Kathleen Maas

10:30-11:00	*Juvenile Anadromous Salmonid Patterns in Coastal Oregon Watersheds: Disturbance and Land Management Effects in Space and Time* Bruce P. Hanson & Gordon H. Reeves
11:00-11:30	*Temperature and Large Wood Patterns in Forested Coastal Streams* Maryanne L. Reiter and Robert L. Beschta

Day One continued

11:30-12:00	*Discussion*
12:00-1:30	*Lunch*

Trends in Aquatic Communities in Coast Range Streams

Moderator: Paul Adams

1:30-1:50	*The Long Term Response of Resident Cutthroat Trout to Forest Harvest* Pat Connolly
1:50-2:10	*Juvenile Salmonid Assemblage Structure in Coastal Oregon Basins: Integrating the Roles of Ecology and Behavior* Deanna H. Olson
2:10-2:30	*Long Term Patterns of Fish Communities in the Alsea Watershed Study* Stan Gregory & John Schwartz
2:30-3:00	*Discussion*
3:00-3:30	*Break*

Terrestrial Systems

Moderator: Gabe Tucker

3:30-3:55	*Structure, Composition, & Dynamics of Riparian Buffer Strips* Dave Hibbs and Pete Giordano
3:55-4:20	*Dynamics of Planted Conifers and Hardwoods in the Understory of Hardwood Dominated Riparian Zones* Sam Chan
4:20-4:45	*Survival and Growth of Conifers Underplanted or Released in Alder Dominated Coastal Riparian Zones* W.H. Emmingham, Kathleen Maas and G.F. Tucker
4:45-5:00	*Discussion*
5:30-7:30	*Poster Session and Dinner* Organizer: Kathleen Maas

Structure, Composition, and Productivity of Riparian Vegetation in the Oregon Coast Range

Tom Spies, Rob Pabst, John Tappeiner, & Nathan Poage

Notes

A basic understanding of the patterns and process of riparian vegetation is essential for ecologically based management and planning. A set of studies within the COPE "Ecology and Inventory of Riparian Vegetation" project have been undertaken to characterize the composition, structure, dynamics, and productivity of riparian vegetation in relation to geomorphic features of the riparian zone. Some of the preliminary findings of these studies will be reported.

Sampling of unmanaged riparian areas indicates that a gradient of compositional change in vegetation occurs from the streamside into the hill slope forests. The greatest differences in vegetation occur between the valley floor and adjacent hill slopes. Plant species diversity is highest on floodplain of the valley floor and lowest on the adjacent hill slope. Natural regeneration of conifers is low throughout unmanaged forests in the central Coast Range. Salmonberry is the dominant understory species across all geomorphic surfaces. Compositional gradients also occur from first-order to fifth-order streams with the composition of lower order streams nested within larger order streams.

The structure and history of two mature riparian forests representing a conifer dominated site and a mixed deciduous/coniferous site were studied in detail. Results indicate a high degree of spatial heterogeneity in both areas and a developmental history of multiple, patchy disturbances. Regeneration of shade tolerant conifers was relatively common on the conifer-dominated site but essentially absent on the mixed deciduous/coniferous site. Presence of shade tolerant conifer regeneration in the conifer-dominated site was attributed to presence of a local seed source in the form of mature western hemlock trees which established at the same time as the mature Douglas-fir canopy.

A study of 20 even-aged, conifer stands ranging from 19 to 53 years in age was conducted to determine if streamside topographic positions differ in productivity from upper topographic positions. Basal area growth, volume growth, and live tree density did not differ between lower slopes within 50 meters of a stream and mid and upper slopes 50 to 250 meters away from the stream. The

Notes

interaction between stand and topographic position was significant, indicating that in some stands lower slopes were more productive than upper slopes but, that in other stands the reverse was true. Factors that we did not measure, such as soil depth, texture, and rock content may account for the variation.

The results of the studies thus far indicate that the riparian zones are highly complex in composition, history and productivity. Geomorphic setting and stream order can account for some of this variability but much of the variation is a result of other factors such as soil, disturbance history, and initial vegetation conditions. Intensive management of these systems will require site and vegetation specific recommendations beyond simple distance-from-stream rules. Plant species diversity and structural complexity in these ecosystems appears to be strongly controlled by intermediate intensity disturbances, microsites, and individual plants and woody structures that survive major disturbances. We hypothesize that lack of shade-tolerant conifer regeneration on many sites is a result of lack of seed source rather than vegetation competition or seed bed conditions.

Streamside Versus Upslope Breeding Bird Communities in the Central Oregon Coast Range

Kevin McGarigal and William C. McComb

Notes

Despite the perceived ecological and management significance of streamside areas in the moist coniferous and mixed deciduous-coniferous forests of the Pacific Northwest, there is little empirical data on the relative importance of streamside habitat to area avifauna.

We compared breeding bird species diversity, richness, evenness, and individual species' abundance between streamside and upslope areas in six mature, unmanaged forest stands in the central Oregon Coast Range, 1988-89. Bird community composition and structure differed between streamside and upslope areas. Species diversity, richness, total bird abundance, and the abundances of five species were greater ($\underline{P} \leq 0.078$) along upslope transects; two common species were more abundant ($\underline{P} \leq 0.059$) along streams. Upslope areas contributed 61% of the total number of birds detected and exclusively contributed 33% of the species, whereas streamsides exclusively contributed only 9% of the species. Vegetation structure and composition may have been responsible for observed bird distributions.

Management of riparian areas alone (e.g., riparian set-asides) may not meet the needs of several bird species; a landscape-level approach that considers both upslope and riparian habitat in conjunction may be more effective in meeting the needs of the entire breeding bird community. Moreover, our results highlight the need to reconceptualize streamside values for terrestrial birds in moist coniferous and mixed coniferous-deciduous forests of western Oregon.

Small Mammals & Amphibians in Coast Range Riparian Ecosystems

Douglas M. Gomez & Robert G. Anthony

Notes

We investigated species composition and relative abundance of small mammals and amphibians in riparian and upslope habitats in five different forest types in the Coast Range of Oregon. The five forest types sampled were grass-shrub, open sapling-pole, large sawtimber, and old-growth conifer forests plus mature deciduous stands. Species richness of small mammals was similar between riparian and upslope habitats, but some species were more abundant along streams. The shrew-mole, Pacific water shrew, Pacific shrew, long-tailed vole, Townsend's vole, white-footed vole, and Pacific jumping mouse were captured in higher numbers in riparian versus upslope habitats. The Pacific water shrew was considered to be a riparian obligate species, and the Pacific shrew, long-tailed vole, and white-footed vole were considered riparian associates. Red-backed voles were more abundant in upslope than riparian habitats. Total captures of small mammals was highest in deciduous forests and progressively lower from shrub to old-growth coniferous forests.

Species richness of amphibians was similar between stream and upslope habitats; however, number of captures was higher in riparian than upslope habitats. Tailed frogs, Dunn's salamanders, rough-skinned newts, Pacific giant salamanders, and red-legged frogs were captured in higher numbers in riparian than upslope habitats. Tailed frogs and Dunn's salamanders were considered to be riparian obligates, and rough-skinned newts and Pacific giant salamanders were considered riparian associates. *Ensatina* salamanders were more abundant in upslope than riparian habitats. Species richness was similar among the different forest types, but total number of captures was highest in deciduous forests, intermediate in mature conifer forests and lowest in the younger conifer forests.

Small riparian systems along second- to fourth-order streams and upslope habitats provide important habitat for small mammals and amphibians in the Oregon Coast Range. These species should not be overlooked in management plans for forests in this area.

Research on Bat Populations in Riparian Areas of the Oregon Coast Range

John Hayes & Pat Hounihan

Notes

Studies of several species of vertebrates are beginning to clarify the relationships of wildlife populations with habitat structure and are enabling evaluation of the influence of management activities on wildlife populations. However, our information base for some species remains woefully inadequate. In this talk we describe a new Adaptive COPE study that investigates an important wildlife group that is generally neglected in wildlife studies, bats.

Bats are extremely important to the region's biodiversity and ecology. Nearly 20% of the mammal species occurring in the Oregon Coast Range are bats. Of 13 species of bats occurring in the Coast Range and Siskiyous, three are listed as sensitive species by the Oregon Department of Fish and Wildlife, and one of these is a candidate for federal threatened or endangered status. Bats are significant predators of nocturnal insects, some of which are forest pests.

We have begun to assess activity patterns and habitat utilization of bats in riparian areas and adjacent upslope habitats by monitoring their echolocation calls. During the first field season of the study we refined our techniques for montoring and identification of echolocation calls. We also gained valuable insights into temporal variation in bat activity that are essential in determining experimental design for further study. Results from this study will provide the scientific basis for appraisal of management alternatives that may influence bat populations in and adjacent to riparian areas.

In this talk we present the rationale for studying bats, methodology being used, and some preliminary findings.

Juvenile Anadromous Salmonid Patterns in Coastal Oregon Watersheds: Disturbance and Land Management Effects in Space and Time

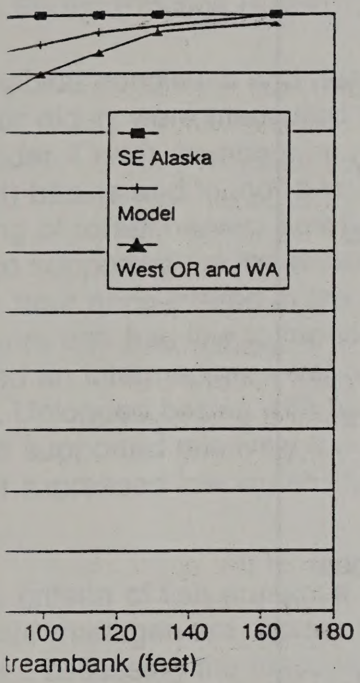
Bruce P. Hansen & Gordon H. Reeves

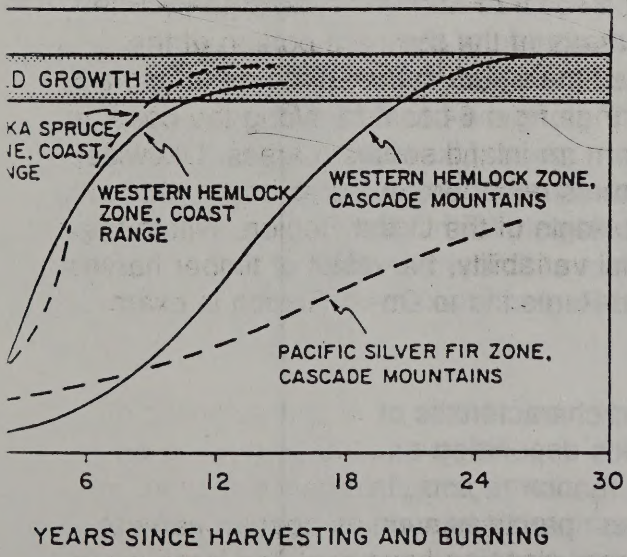
The natural disturbance regime in coastal Oregon basins can establish a range or domain of possible watershed characteristics which may delimit current and possible future stream habitat conditions. Watershed and stream habitat conditions within this domain can be a function of factors such as type of disturbance, hydrology, local geography, geology, vegetation and time. Timber harvest can be viewed as a disturbance that constrains the range of possible conditions. Current fish assemblages reflect the extant position of the stream within this domain.

The relationship of timber harvest, stream complexity, and diversity of juvenile anadromous salmonid assemblages in 14 small to intermediate-sized basins was examined between 1985 and 1989. Assemblage diversity (the inverse of a species dominance index) in streams in basins with low harvest levels (<=25% of the basin harvested) was greater than in streams in basins with higher harvest levels (>25% of the basin area harvested). Lower diversity in higher harvest basins resulted from salmonid assemblages dominated by single species. Stream habitat features were compared between streams with low and high harvest levels. Streams in basins with low timber harvest had more complex habitat, as manifested by more large pieces of wood and more pools per 100 m.

A community and basin level perspective is suggested to fully assess the effects of disturbance, timber harvest, and other human activities on stream fish.

from streams throughout the Coast Range. Management practices have altered the large wood component by direct removal or breakage during harvest. Historical management practices in conjunction with natural disturbance patterns such as fires, floods, and windstorms have served to create and maintain extensive alder-dominated riparian systems throughout forested coastal streams of the Pacific Northwest.





Temperature and Large Wood Patterns in Forested Coastal Streams

Maryanne L. Reiter and Robert L. Beschta

Stream temperatures and large woody debris are important parameters affecting the quality of riparian and aquatic ecosystems. Stream temperature influences both the chemical and biological components of a stream while large wood predominantly affects the physical characteristics of a stream. Both stream temperature and large wood have received considerable attention for their role in the maintenance of fish health and habitat over the past several decades.

The coastal region of the Pacific Northwest is characterized by high rainfall, moderate summer and winter temperatures, mixed sedimentary and volcanic geology, and rapidly growing forests. Most of the Coast Region drainage basins originate in the within the Coast Range Mountains. However, two large basins in the southern portion of the region originate in the Cascades (the Rogue and Umpqua). These physical characteristics, combined with diverse land use practice histories and natural disturbance regimes, have created and continue to influence spatial and temporal patterns of stream temperature and large wood.

The Coast Region, unlike other regions of the state, does not generally exhibit a strong relationship between elevation and air and stream temperatures due to the moderating effect of a marine climate regime. However, a latitudinal gradient is apparent in the inland portion of the Coast Region. Mean annual maximum air temperatures range from 57 to 62°F along the coast to 65°F in the more inland areas of the southern portion of the coast. While mean maximum summertime air temperatures generally range from 64 to 69°F along the coast to 76 to 82°F in the more inland southern areas. Likewise, higher summertime stream temperatures occur within the inland southern portion of the Coast Region. Within the context of regional variability, the effect of timber harvest on stream temperatures in the Coast Region is examined.

The frequency, species, volume, and characteristic of large wood in the Coast Region varies depending on land use history, landform, and disturbance regime. In general, past forest practices such as riparian harvest, salvage, and stream cleaning have depleted large wood

The Long Term Response of Resident Cutthroat Trout to Forest Harvest

Pat Connolly

Notes

Resident cutthroat trout are often the only salmonid fish species occupying first and second order streams in the Oregon Coast Range. This study characterizes the response of resident cutthroat trout to the kind of logging practiced before the adoption of Oregon's Forest Practice Act in 1972. Most forests that will be mature enough for a second harvest within the next 30 years were harvested before the implementation of the first set of Oregon's Forest Practice Rules.

Stream habitat conditions and density of cutthroat trout (age 1+ or older) were measured for streams within small (under 4 km^2), homogeneously treated (logged or unlogged) basins and found to vary with the presence and timing of forest harvest activity. Basins logged 20-30 years ago supported the lowest and highest densities of cutthroat trout encountered in the study. Basins logged 40-60 years ago had low to moderate densities and expressed an intermediate level of variability among streams. Unlogged basins with tree stands 125-200 years old supported relatively low densities of cutthroat trout and expressed low variability in densities among streams.

Because criteria of fish presence (and until recently, fish size) guide management decisions on degree of stream protection, assessing the response of the fish population to a prior logging event can be important for maintaining a basin's potential for supporting cutthroat trout population if it is to be logged again.

Juvenile Salmonid Assemblage Structure in Coastal Oregon Basins: Integrating the Roles of Ecology and Behavior

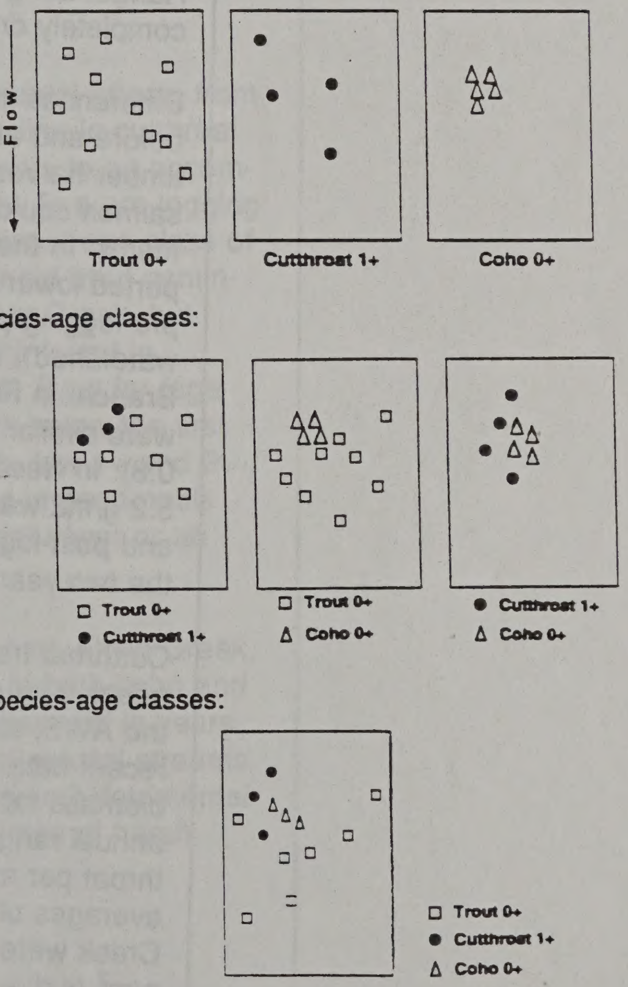
Deanna H. Olson

Notes

Juvenile salmonid diversity patterns in coastal Oregon basins may reflect fish physical habitat associations and their biotic interactions. Reeves et al. (1993: Trans. Amer. Fish. Soc. 122:309-317) proposed that patterns of low juvenile salmonid diversity in coastal basins with high levels of timber harvest may be related to the reduced physical habitat complexity of those streams. Their suggestion that stream habitat simplification may affect fish assemblage structure and composition is being addressed in a study of juvenile salmonid assemblages in coastal streams of central Oregon. The objectives of this study include: 1) an examination of the associations of species-age classes with physical habitat and microhabitat features, and 2) an examination of the potential effects of biotic interactions among the fishes on assemblage structure. Four salmonid species-age class groups are easily distinguished in these systems during summer low-flow conditions: age 0+ years coho salmon (*Oncorhynchus kisutch*), age 1+ years cutthroat trout (*O. clarki*), age 1+ years steelhead trout (*O. mykiss*), and 0+ trout (cutthroat and steelhead combined).

Lower diversity of these juvenile salmonids generally results from a reduced abundance of trout and a higher number of coho salmon. The integration of data quantifying habitat availability with species-age class habitat and microhabitat associations can contribute to explanations of diversity patterns in coastal basins. For example, juvenile coho salmon generally are distributed in the mid-to-tail portions of pools, which are areas that can be greater in streams in areas with higher timber harvest. The higher relative abundance of coho in such systems may be in direct response to greater habitat availability. In contrast, age 1+ trout generally use microhabitats towards the upstream head of pools. As pool numbers are reduced and surface areas increased, as can occur in basins with higher timber harvest (e.g., this study, Reeves et al. 1993), the number of these areas is likewise reduced.

The behavioral ecology of these juvenile salmonids also may affect diversity patterns. Instream observations and experiments show that age 0+ coho salmon have a greater tendency to aggregate than the trout species-age classes, and coho distributions and behaviors do not appear to be affected by the presence of other fish in a pool assemblage (Fig. 1). In contrast, the juvenile trout species-age classes do not have such a tendency to school and are often regularly spaced in pools (Fig. 1). As assemblage composition varies, trout species-age classes have different distribution patterns and microhabitat associations (Fig. 1). Increasing coho salmon pool densities appears to displace the trout from microhabitats, and could affect their utilization of optimal habitats. In addition, 1+ cutthroat trout are especially sensitive to instream and streamside activities, which could increase their vulnerability to losses in a managed system.



Fish distributions in pools with a single species-age class:

[coho aggregated, trout spacing was more uniform]

Fish distributions in pools with two species-age classes:

[coho distribution has not changed, trout spacing has changed]

Fish distributions in pools with three species-age classes:

[pattern is analogous to that seen in natural pools with 1+ cutthroat near the pool head and max. depth area, coho mid-pool, and 0+ trout nearer the pool margins]

Figure 1. Schematic diagrams of general two-dimensional distribution patterns of juvenile salmonids during instream pool experiments designed to control species composition and density. Pool compositions were manipulated to create assemblages with one, two, and three species-age classes.

Notes

Long-term Patterns of Fish Communities in the Alsea Watershed Study

Stan Gregory & John Schwartz

The Alsea Watershed Study (AWS) is one of the few long-term watershed studies to document effects of timber harvest practices on stream habitat quality and salmonid populations. The Fish Habitat Project of COPE has resurveyed the AWS streams to examine the status of fish communities approximately two and a half decades after timber harvest. Three small coastal streams were studied seven years prior to timber harvest to establish the natural annual variation in salmonid populations and were monitored for another seven years after timber harvest. In 1988-1993, salmonid populations were estimated by the removal (multiple pass) method with electroshocking. Needle Branch was not electrofished in 1988 and 1992 because of drought conditions in the Oregon Coast Range. Long sections of Needle Branch were completely dry in late summer.

Differences in abundance of juvenile coho salmon before and after logging could not be attributed to timber harvest. Differences in biomass of juvenile coho salmon could not be attributed to timber harvest treatments. In the AWS, juvenile coho biomass was reported lower in the post-logging period than the pre-logging period for Flynn Creek (the unharvested watershed), and higher for Deer Creek and Needle Branch. In Flynn Creek, biomass estimates after 1988 were similar to the overall average of 2.2 g/m^2 (s.d. = 0.8). In Needle Branch, the 1989 biomass estimate of 5.2 g/m2 was substantially greater than the AWS pre- and post-logging averages but was essentially zero for the two years in which the stream stopped flowing.

Cutthroat trout in Needle Branch were detrimentally affected by clearcut logging without bufferstrips during the AWS, and long-term effects were indicated by recent data. In Flynn Creek, areal densities and biomass for cutthroat trout after 1988 were within the annual range reported by the AWS, 0.20 - 0.38 cutthroat per m^2 and 2.7 - 5.8 g/m^2, respectively. Overall averages of areal densities and biomass in Flynn Creek were 0.28 cutthroat per m^2 (s.d. = 0.05) and 3.7 g/m^2 (s.d. = 0.8), which were similar to estimates after 1988. In Deer Creek, areal densities and biomass for 1988 were the lowest estimates in all years surveyed,

and for 1989 they were lower than pre- and post-logging averages. Cutthroat trout population in Deer Creek have declined since the AWS as suggested by the recent data. In Needle Branch, cutthroat areal density for the period after 1988 was below the AWS pre-logging average by 50%, and biomass for Needle Branch in 1989 was below that of AWS pre-logging averages.

Populations of juvenile coho and cutthroat trout were quite variable annually in these small AWS streams. In Flynn Creek, the overall coefficient of variation is 50% for juvenile coho and 20% for cutthroat trout. Coho densities in Deer Creek and Needle Branch exhibited coefficients of variation of 27% and 43%, respectively. Cutthroat densities from pre-logging years in Deer Creek and Needle Branch exhibited coefficients of variation of 10% and 27%, respectively.

Cutthroat trout showed long-term detrimental effects from clearcutting without bufferstrips. The decline in cutthroat trout abundance in Needle Branch appears to be accompanied with a shift in age-class structure. In a pre-logging year (1962), all streams showed a dominant age class of one-year-old trout. After 1988, one-year-old trout continued to dominate in Flynn Creek and Deer Creek, but young-of-the-year in Needle Branch were found in greater numbers than older age classes. Trout fry (age 0+) were found only within a short reach below the first falls. In lower reaches of Needle Branch, few 1+ and 2+ trout were captured, and these occurred in deep pools having some CWD (coarse woody debris) cover or an undercut bank.

Invasion of beaver in the control watershed, Flynn Creek, caused an 80% increase in abundance of both coho and cutthroat trout. These increases were observed in years in which coho densities declined in most coastal streams. Beaver may serve as a natural buffer against detrimental changes in salmon populations during times of harsh environmental conditions.

Structure, Composition, & Dynamics of Riparian Buffer Strips

Dave Hibbs & Pete Giordano

Notes

There have been two studies of succession in Coast Range alder stands: one in riparian areas and one on hill slopes. Both reached similar conclusions. First, as the tree canopy aged, the height and cover of the shrub layer increased. Second, tree regeneration in these aging alder stands was very rare and, where found, tended to occur on woody debris.

Riparian management practices of the last couple of decades have focused on creating buffer strips along streams, narrow strips of intact forest adjacent to clear-cuts. These strips are left to provide short-term stream cover and protection from erosion. They are also left to provide a long-term source of shade and large woody debris. Because many of these buffer strips in the Coast Range are alder dominated, concerns have been raised about the real, long-term value of alder-dominated buffer strips. Specifically, would the environmental changes associated with becoming a buffer strip hasten the senescence of the overstory, increase the vigor of the understory shrubs, and further reduce conifer regeneration.

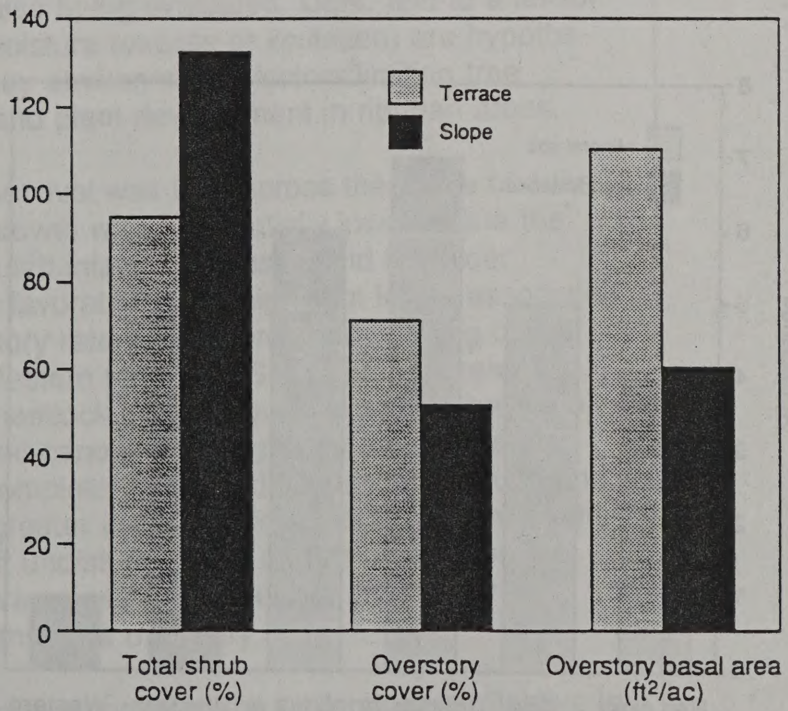
We have done a chronosequence study of alder-dominated buffer strips in an attempt to address these concerns. We sampled 54 Coast Range buffer strips which ranged in age from 0 to 33 years since adjacent cutting.

Some of our results surprised us. We did find that there was an increase in shrub cover when buffer strips were compared with riparian communities with intact adjacent forest, but there was no increase in shrub cover over the 33 years of the chronosequence. We had expected to see shrub cover continue to increase in response to the increased sun light. It may be that, in 33 years, the adjacent forest regrows sufficiently to eliminate this light. We also found no evidence of increased rate of senescence of the alder overstory. We did find, as the succession studies have, that shrub cover increases with overstory age and that the limited conifer regeneration is found primarily on woody debris. We found only 28 seedlings among the 54 sites (1.7 ha sampled).

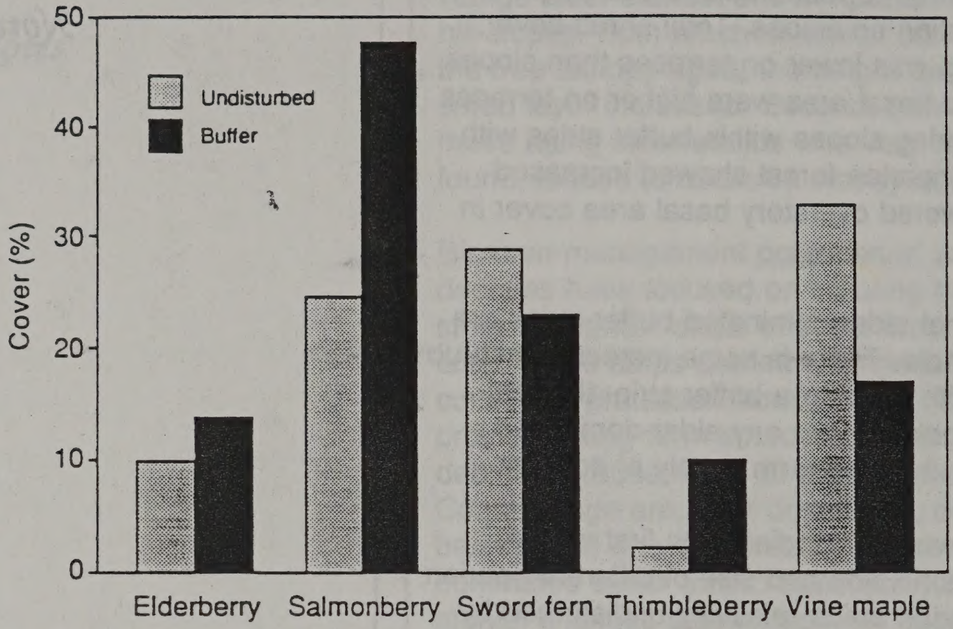
Geomorphology was important to riparian vegetation structure. Vegetation on terraces adjacent to streams differed from vegetation on slopes. Total shrub cover, including sword fern, was lower on terraces than slopes. Overstory cover and basal area were higher on terraces than slopes. Comparing slopes within buffer strips with slopes within intact riparian forest showed increased shrub cover and lowered overstory basal area cover in buffers.

Our conclusion is that alder-dominated buffer strips are quite biologically stable. There is some increase in shrub cover associated with creating a buffer strip; the real concern is that associated with any alder-dominated riparian community: the long-term supply of conifers.

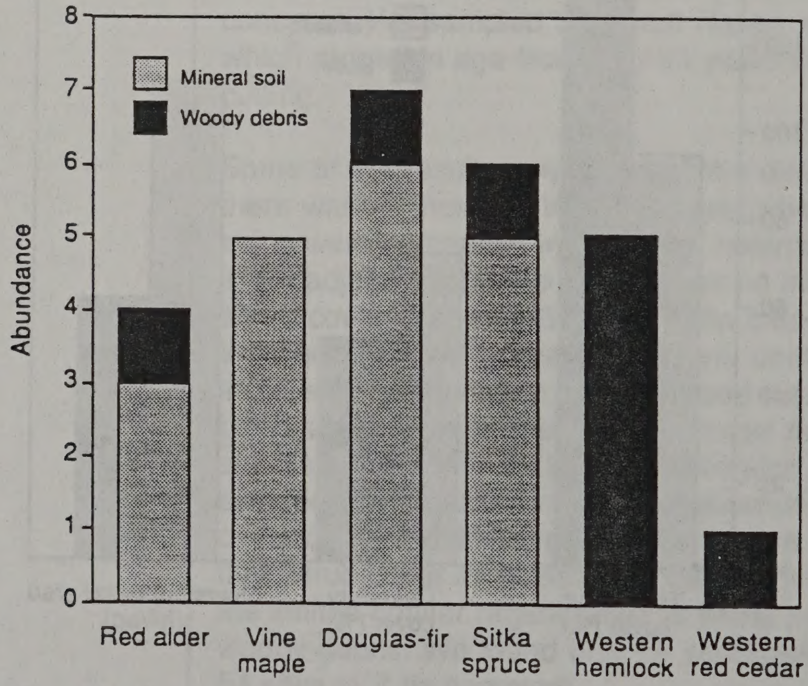
We are beginning two new studies. The first will be documenting the distribution and size of different riparian communities in riparian areas relatively undisturbed by humans. The second looks at the finer-scale of both the horizontal and vertical structural pattern of vegetation in riparian plant communities.



Vegetation characteristics and geomorphology of buffer strip alder riparian areas.



Cover of primary shrub species in undisturbed and buffer strip alder riparian areas.



Regeneration in alder riparian areas.

Dynamics of Planted Conifers and Hardwoods in the Understory of Hardwood Dominated Riparian Zones

Sam Chan

Coastal streams dominated by red alder and an understory of salmonberry create environmental and microsite conditions that often exclude tree regeneration. Identifying the growing conditions that affect the dynamics of conifer, hardwoods, and shrubs is a crucial step in designing prescriptions for restoration in hardwood and shrub dominated riparian areas.

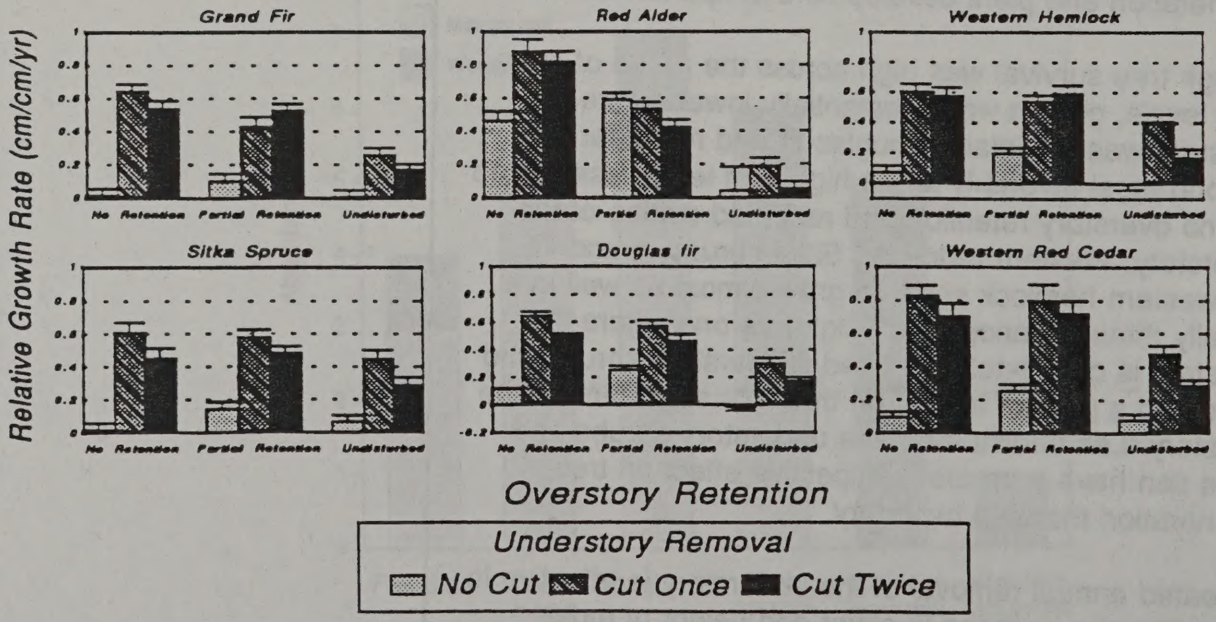
The physical environment of riparian areas is diverse and complex. Microsite variations in soil, drainage, light, topography, and edge occur within short distances. This complexity results in the development of a range of growing conditions that may favor or preclude the development of different species.

A current study in red alder/shrub dominated riparian areas in the Oregon Coast Range is assessing the response of planted red alder, grand fir, western redcedar, Douglas-fir, western hemlock, and Sitka spruce seedlings to growing conditions under different densities of hardwood overstory and understory shrub cover and physical site characteristics. Response of overstory hardwoods and understory plants to gradients in growing conditions is also being evaluated. Light, and to a lessor degree, soil moisture (excess or limitation) are hypothesized as the key environmental factors limiting tree regeneration and plant development in riparian areas.

Though tree survival was high across the range of overstory levels, growth was substantially lower where the overstory was left intact. Douglas-fir and red alder respond most favorably to the high light levels associated with no overstory retention and repeated cutting of the understory. Western redcedar, Sitka spruce, grand fir, and western hemlock seem to grow almost as well in a partially thinned canopy (60% light) as one where the overstory is completely removed. Understory shrubs and herbs had a greater impact on tree mortality than did the overstory. Left undisturbed, the understory shrubs and herbs can have a greater competitive effect on tree regeneration than the overstory.

Repeated annual removal of the understory is effective in preventing the increase in cover and height of most shrubs. Reduction of height and cover of salmonberry through cutting was most effective under an undisturbed overstory. Removal of the overstory favors the development of herbs as well as shrubs. The greater the cutting intensity, the higher the shift to herbs. Although riparian areas are usually not considered to be moisture limiting, the development of dense herbaceous foliage in soils of low water-holding capacity can lead to water limiting situations for trees with poorly developed root systems.

Successful regeneration of trees in hardwood shrub dominated riparian areas will likely require active management of the vegetation to promote the successful establishment and growth of trees. This may mean that short-term disturbances are necessary to achieve long-term riparian restoration goals. Elimination of hardwoods and shrubs is unlikely to occur through mechanical means, nor would it be ecologically desirable. However, substantial thinning of the hardwood and shrub complex may be necessary to create conditions favorable for the establishment of trees to provide vegetative complexity and woody structure. Growing conditions and vegetation development are not static. An active monitoring and evaluation program is critical to determine if management/restoration objectives are being met.



Relative stem diameter growth rates as functions of overstory and understory disturbance. Indian Creek - third year.

Survival and Growth of Conifers Underplanted or Released in Alder Dominated Coastal Riparian Zones

W.H. Emmingham, Kathleen Maas and G.F. Tucker

INTRODUCTION

Many coastal riparian zones have few conifers to provide persistent structural material to enhance stream habitat, especially in areas logged prior to required buffer strip regulations. Logging disturbance encouraged establishment of hardwood dominated stands with exclusion or suppression of conifers. Two Adaptive COPE studies were established; one on release of established conifers, and a second focused on underplanting of conifers in the hardwood dominated riparian zones. Field trials were established to determine survival and growth of seedlings and saplings in managed and unmanaged conditions.

Eleven alder dominated riparian zones spanning a range of sites from Port Orford in the south to Astoria in the north were selected to study the survival and growth of seedlings and saplings in managed and unmanaged conditions.

CONIFER RELEASE

At five sites 261 conifers overtopped by fast growing alder were released. Douglas-fir, western hemlock and western redcedar seedlings and saplings found in the understory were randomly assigned one of three treatments: 1) release by cutting, 2) release by girdling, or 3) no release. The alder within a radius equal to 1/4 the total height of the alder were felled by chainsaw, or girdled with an ax around the release tree.

Mean three year survival ranged from 73 to 95% on the five sites, but did not vary significantly by site. Western redcedar had better survival (95%) than western hemlock (75%) but was not significantly greater than Douglas-fir (78%). Mean survival for Douglas-fir and hemlock was greater where overstory trees were girdled or cut. Western redcedar survival was 90% or better in all treatments.

Three years after installation, overstory removal treatments tended to increase both diameter and height growth but only diameter growth showed significant differences. Mean three year diameter growth of 1.7 cm where alder were cut down was greater than 0.6 cm in

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the undisturbed stands. The more shade tolerant hemlock and redcedar tended to grow better in diameter than Douglas-fir in all treatments, but trends were not statistically significant.

UNDERPLANTING

Six sites were selected to study the response of planted Douglas-fir, grand fir, western hemlock and western redcedar. Because seedlings planted in different sites varied by stocktype and size, relative growth rates (i.e., size adjusted) were used in the analysis. Overstory treatments were; all trees girdled, 50% of trees girdles, and no trees girdled. Understory treatments were control of competing herbs and shrubs or no control. Mechanical cutting and herbicide treatments were split evenly among the sites. Half of the planted trees were protected by 24in. plastic mesh tubing. By the end of the third growing season, ocular estimates of overhead cover were 95, 55, and 8% for undisturbed, partial girdle and total girdle treatments respectively.

Survival varied by site with good sites having 68 to 73% and poor sites having 52-60% after three years. Both overstory and understory vegetation control increased survival, but the plastic tubing had no effect on survival or height growth. Although redcedar survived better than the other species, growth was similar to growth in the other species. Hemlock grew best in both height and diameter, while Douglas-fir grew less in diameter than the other species.

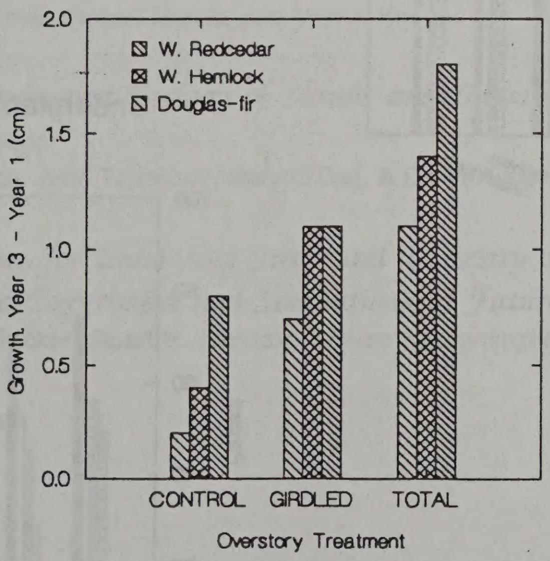
After three years, both overstory manipulations stimulated better relative height growth than control. Trees in total overstory girdling were superior in diameter growth. Tubing had no significant beneficial effects. By year three, beneficial effects of understory treatment were still seen in survival and both growth measurements, even though the understory vegetation had rebounded to earlier original conditions.

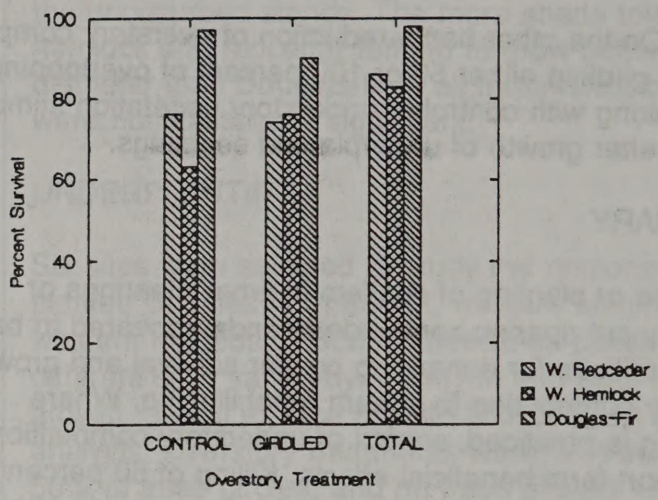
Results of survival and growth trials and observation of vigor confirmed that underplanting without overstory treatments has little prospect of producing large conifer trees. On the other hand, reduction of overstory competition by girdling either 50 or 100 percent of overtopping alder along with control of understory vegetation stimulated better growth of underplanted seedlings.

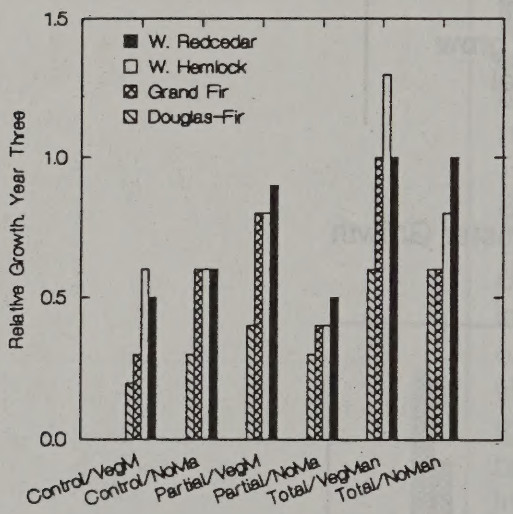
SUMMARY

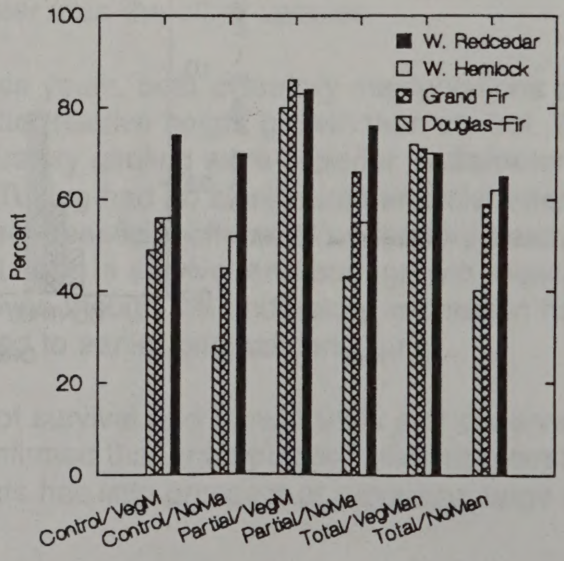
Release or planting of conifers in small clearings or partially cut riparian zone alder stands appeared to be viable options for enhancing conifer survival and growth, thereby contributing to stream rehabilitation. Where planting is practiced, control of understory competition has short term beneficial effects. Killing of 50 percent of the alder (i.e., thinning) appeared to be a good option for restoration in the short run, but length of treatment effect should be determined. Duration of beneficial effect of thinning would depend on age and density of residual alder, and site conditions. The more shade tolerant species did better, but Douglas-fir did survive and grow when released and underplanted with modest initial success.

Release Study Diameter Growth




Release Survival After Three Years


Relative Basal Diameter Growth, Underplanting


Underplanting Survival, Year Three

Day Two

Stream Ecosystem Restoration

Moderator: Arne Skaugset

8:00-8:15 *Influence of Habitat Complexity and Food Availability on the Fish Community in an Oregon Coastal Stream*
Stan Gregory and Steve Fieth

8:15-8:30 *The Effect of Woody Debris Size and Orientation on Aquatic Habitat in Coast Range Headwater Streams*
Elizabeth Dent, Arne Skaugset, Doug Bateman, and Pat Connolly

8:30-8:45 *Discussion*

Upslope Ecology and Management

Silviculture and Plant Ecology

Moderator: Bill Emmingham

8:45-9:10 *Conifer Species Susceptibility to Phellinus weirii: Long-term Studies*
Walter G. Thies, Robert Merola, and Mari J. Kramer

9:10-9:35 *The Reproductive Ecology of Shrubs and Broadleaved Trees in the Oregon Coast Range*
John Zasada, John Tappeiner, Mary O'Dea, & David Huffman

9:35-10:00 *Silviculture for Enhancing Structural Diversity of Young Forests - A Controlled Experiment and Simulations of Future Stand Development*
Gabriel F. Tucker, Stuart R. Johnston, William H. Emmingham, & Steven L. Garman

10:00-10:30 *Discussion*
10:30-11:00 *Break*

Day Two continued

Wildlife

Moderator: Nobuya Suzuki

11:00-11:30 *Responses of Vertebrate Communities to Stand and Landscape Patterns In Natural and Managed Forests in Western Oregon*
Andy Hansen

11:30-12:00 *Relationship Between Landscape Structure and Breeding Birds in the Oregon Coast Range*
Kevin McGarigal and William C. McComb

12:00-12:30 *Discussion*

12:30-1:50 *Lunch*

Landscape & Community Perspectives

Moderator: Steve Hobbs

1:50-2:35 *Coastal Landscape Analysis and Modeling Study (CLAMS)*
Thomas A. Spies, Joseph E. Means, K. Norman Johnson, Warren C. Cohen, William C. McComb, Gordon H. Reeves, & Steve Garman

2:35-3:05 *Management Policies for Increasing Recreation's Contribution to the Economies of Oregon Coast Range Communities*
Rebecca Johnson & Kreg Lindberg

3:05-3:305 *Break*

Perspectives and Directions for the Management of Oregon Coast Range Forests - a Panel Discussion

Moderator: John Hayes

3:35-5:15

Speakers:

Vic Kacynski	Fisheries Biologist and private consultant
Reed Noss	Editor of Conservation Biology, & Dept. of Fisheries and Wildlife, OSU
Jim Furnish	Acting Supervisor, Siuslaw National Forest
Bart Starker	Executive Vice-president, Starker Forests
Jack Shipley	Applegate Partnership Board Member

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controls (p=0.0034). For coho, dace, and sculpin biomass, there was no statistical difference detected between the treatments. Juvenile coho had significantly higher biomass with food addition (p=0.0274). Growth rates of coho were significantly higher in pools with added food. No difference in biomass was detected for cutthroat, dace, and sculpins.

Both total fish biomass and cutthroat trout increased with increasing structural complexity. Biomass was higher in all three treatments relative to reference pools. Data indicate cutthroat biomass increases with increasing structural complexity during winter. Cutthroat distribution and abundance may be tightly linked to structural complexity (LWD) across seasons. Cutthroat response in all treatments in August was highly variable indicating other factors may have been influencing its distribution.

Coho biomass did not appear to be associated with structural complexity in June. Recent work by ODFW indicates structural complexity may be more important to coho during winter. The feeding experiment indicates that food is an important factor influencing the distribution and biomass of coho juveniles in summer.

The full response of the fish community to the LWD treatments may have a lag period associated with it. Therefore, valuable information will be obtained with continued monitoring in the COPE research program. Additionally, some benefits of the LWD introductions (i.e., increased retention of organic material, refuge for organisms during flood events) should become more pronounced through time. Restoration of stream ecosystems will not occur in a few years or even decades. Ecosystem restoration requires the recovery of ecological processes that shape and maintain natural communities. Given the critical role of restoration, rigorous experimentation and monitoring are essential to design ecologically sound resource management policies.

Influence of Habitat Complexity and Food Availability on the Fish Community in an Oregon Coastal Stream

Stan Gregory and Steve Fieth

Recent studies on stream restoration practices in the PNW have attempted to determine factors limiting populations. Much of this work has examined physical aspects of habitat without addressing other potentially important factors. Most studies have focused on a single species of interest without examining entire fish communities. The majority of stream "restoration" projects have been conducted with little or no experimental design or subsequent evaluation. In the COPE fish habitat research project, we initiated an experimental field manipulation in cooperation with the Siuslaw National Forest.

The experiment was designed to examine two factors: structural complexity, and food availability. The study objectives were to determine if fish biomass increases with increasing structural complexity using large woody debris (LWD), and determine if fish biomass increased with increasing food availability.

The study was conducted on a 2.5 km reach of Camp Creek in the Alsea River drainage. Thirty-two pools were selected for experimental manipulation. The treatments were: 1) a reference pool, 2) low complexity (2 large logs), 3) medium complexity (3 large logs; 2 tree tops), and 4) high complexity (5 large logs; 5 tree tops). Treatments were installed in September 1991. We standardized all treatments for experimental purposes. Therefore, the project did not take advantage of habitat features that might have been emphasized by normal rehabilitation efforts by the Forest Service. Fish species present in Camp Creek include coho salmon, cutthroat trout, steelhead trout, speckled dace, and two species of sculpins. In June 1992, the fish community was sampled using pass-removal electroshocking to determine distribution and abundance of all fish species. In July, one-half of the blocks were randomly selected to receive a feeding treatment. Selected pools received 25 grams of freeze-dried krill per day, six days a week, for six weeks. After a six week treatment period, pools were sampled again. Salmonids comprised approximately 35% of the fish community biomass, and dace and sculpins accounted for approximately 10% and 45% respectively. Total fish biomass increased with increasing levels of structural complexity (p=0.0955). Cutthroat trout biomass was significantly higher in all treatments relative to

The Effect of Woody Debris Size and Orientation on Aquatic Habitat in Coast Range Headwater Streams

Notes

Elizabeth Dent, Arne Skaugset, Doug Bateman, and Pat Connolly

The importance of large woody debris (LWD) as a component of forested stream systems is becoming widely recognized and well documented. However, the influence of LWD characteristics, such as diameter and orientation, on debris function and instream processes is not well documented. This Adaptive COPE study was undertaken to determine the effect of LWD size and orientation on debris piece stability, pool morphology, and quality and quantity of aquatic habitat.

Debris pieces ranging in diameter and orientation were installed in two headwater streams, J-line and Preacher Creeks, in the Oregon Coast Range. We installed 18 limbed and bucked conifer logs on each stream. The treatments consist of three diameter classes - 8, 16, and 24 inches, and two orientations - perpendicular to streamflow (a spanner), and angled down into the channel from the streambank (a ramp). There were six pieces in each diameter class of which three were spanners and three were ramps.

Prior to installation of LWD in 1989, we conducted topographic surveys of the stream channels. We repeated these surveys during three of the post-treatment years. We compiled topographic maps from the survey data and assessed debris piece movement and changes in channel scour and fill over time. The effects of debris diameter and orientation on pool area and residual pool volume were analyzed. In general, residual pool volumes associated with spanners tend to be greater than those associated with ramps.

Fish population and habitat surveys have been conducted annually since 1989. Correlation of salmonid densities with LWD installations indicate the influence of debris characteristics on aquatic habitat quality. There tend to be greater numbers of fish associated with larger diameter spanners than with untreated and ramp habitat.

Conifer Species Susceptibility to Phellinus weirii: Long-term Studies

Walter G. Thies, Robert Merola, and Mari J. Kramer

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Laminated root rot is the most important single natural agent of change operating in coastal Oregon forests. These changes, brought about by root pathogens, are part of a normal, healthy ecosystem and are neither good nor bad, except as they relate to human values. A stand with significant disturbance from mortality or growth loss due to this disease may at once show a significant reduction in fiber production and an increase in diversity. Increased diversity arises from the pathogen selectively reducing the population of some hosts as well as opening the stand, thus freeing resources and creating the disturbance necessary to allow additional species to successfully compete. By influencing the structure and composition of the overstory vegetation, root pathogens profoundly affect the understory vegetation, the below ground ecosystem and the animals that are an important part of these communities. The impact of the disease must be measured against the long term goals of the land manager.

Opportunities to influence laminated root rot usually come at the time of stand regeneration when we can easiest influence either the amount of residual inoculum by treating stumps or stand composition through selection of species to be grown. While all hardwoods are immune to laminated root rot, nearly all conifer species appear to be susceptible to some degree. The relative susceptibility of six commercial conifer species to laminated root rot is being tested in four geographically separated sites in the Oregon Coast Range as part of the COPE program. The tested species are Douglas-fir, grand fir, western hemlock, noble fir, western white pine, and western redcedar.

Although installation of the study is nearly complete, full expression of the disease, and hence, decisions about species susceptibility may require 15 years. Inoculum distribution on these four sites was in a diffuse pattern and not clustered in "pockets" as is the stereotyped pattern. The presence of a diffuse pattern of inoculum distribution will require a rethinking of mitigative strategies.

The Reproductive Ecology of Shrubs and Broadleaved Trees in the Oregon Coast Range

John Zasada, John Tappeiner, Mary O'Dea, & David Huffman

Notes

Shrubs and broadleaved trees are important components of the forests of the Oregon Coast Range. Their presence is frequently viewed as detrimental, because they respond rapidly following forest harvesting, and compete for site resources with Douglas-fir and other conifer seedlings. However, these species play an important role in forest structure, function, and productivity. For example, they are important in nutrient cycling and soil stability, and they provide food and cover for wildlife. Additionally, some species are used for decorative greenery, providing income for people residing in coastal communities. To meet the management objectives of the various landowners in the Coast Range, it may be desirable to encourage, or discourage, the distribution and growth of these species. Developing management alternatives for these species requires an understanding of their growth and reproductive characteristics, and the effect of biotic and abiotic factors on them. The objective of our work has been to develop a better understanding of seed and vegetative reproduction in these species and how they are affected by silvicultural practices.

Shrub and broadleaved tree species exhibit a variety of reproductive strategies. The conceptual models, shown in Figure 1, provide a means of understanding the various steps or components in the process of seed and vegetative reproduction. Our work has focused on salmonberry, salal, vine maple, and bigleaf maple. The reproductive characteristics of these four species are representative of the range of reproduction characteristics found in the shrubs and broadleaved trees of the Coast Range. They provide examples of the response which may be expected due to natural and man-caused disturbance and how they can be expected to develop during forest succession. Some key characteristics of the four species are summarized below.

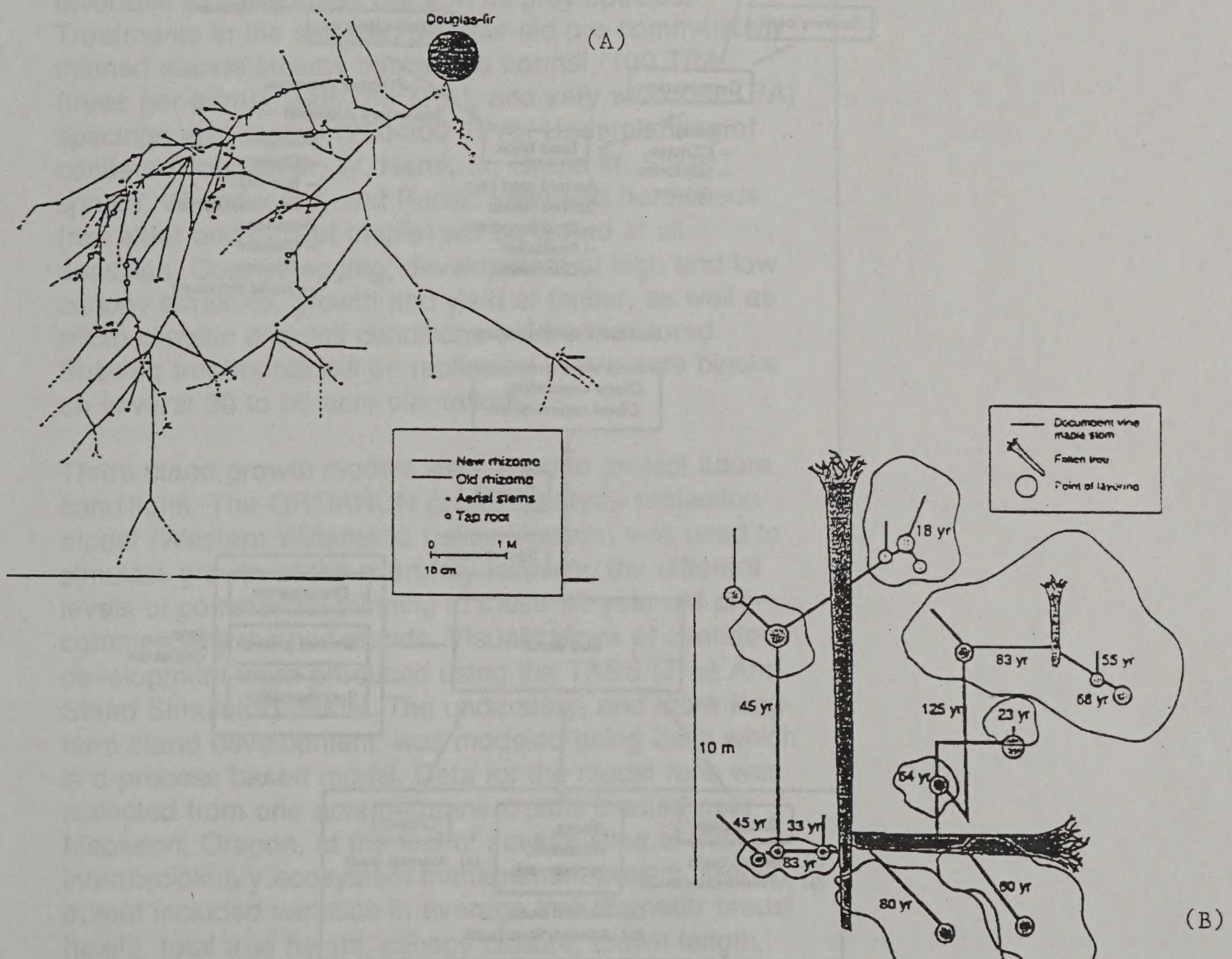
Salmonberry and salal are able to sprout from buds located at the base of the stem and layer when stems are pinned to a suitable sustrate, but their ability to expand rapidly is due to their underground rhizome system (Fig. A). The size of clones and the extent of the rhizome system of a single plant is closely related to stand density.

Both species regenerate from seeds, but reproduction by seeds is more common in stands with open canopies. Seedling growth is slow in comparison to vegetative reproduction. Salmonberry seeds exhibit deep dormancy and may persist in the soil for many years.

Vine maple provides the best example of a shrub able to develop large clones as a result of layering (Fig. B). Layering occurs when a branch or stem produces adventitious roots when pinned to a suitable substrate. Vine maple also reproduces vigorously by basal sprouting. The size and shape of clones in conifer stands is closely related to stand density and the availability of material, such as fallen trees and branches, which can pin vine maple stems to the forest floor or other substrates suitable for rooting. Vine maple also reproduces from seed. Seedlings are more common in clearcuts and in open stands. Seeds germinate over a two to three year period.

Bigleaf maple can reproduce vegetatively or by seeds. Vegetative reproduction occurs exclusively by basal sprouting. Bigleaf maple sprouts can grow rapidly. Of these four species, bigleaf maple attains the greatest size and can dominate conifers for the longest period of time. Bigleaf maple seeds germinate under a wide range of conditions, but seedling establishment is most likely in open stands. All bigleaf maple seeds germinate in the spring following dispersal; there does not appear to be a persistent seed pool. Seedlings are common in some stands and comprise a seedling pool which can occupy forest gaps when they occur.

Management strategies for these species seek to, among other things, reduce the rate of growth, change the growth form of the plant, or alter its distribution on a site. The effects of chemicals and fire are relatively well known but effects of manual treatments and stand density manipulation are only beginning to be studied. For example, manually (chainsaw) cutting salmonberry during the peak of the growing season, reduces the rate of regrowth and extends the time that a treatment is effective relative to a similar treatment during the dormant season. Cutting vine maple during final harvest or thinning operations prevents development of dense stands of vine maple that can occur when stems are flattened. Alternatively, the presence and distribution of these species on a site can be increased by management of overstory density and practices which expand the area occupied by existing plants. For example, vine maple stems can be stimulated to layer by artificially pinning them to the forest floor.



Examples of clones resulting from rhizome system development in salal (A), and layering in vine maple (B). Numbers (18 yr., etc.) indicate age of ramets in the vine maple clone and illustrate the uneven-aged structure that is characteristic of salmonberry, salal, and vine maple clones (figure for salal from Huffman and others (1994) and for vine maple from O'Dea and others (1994)).

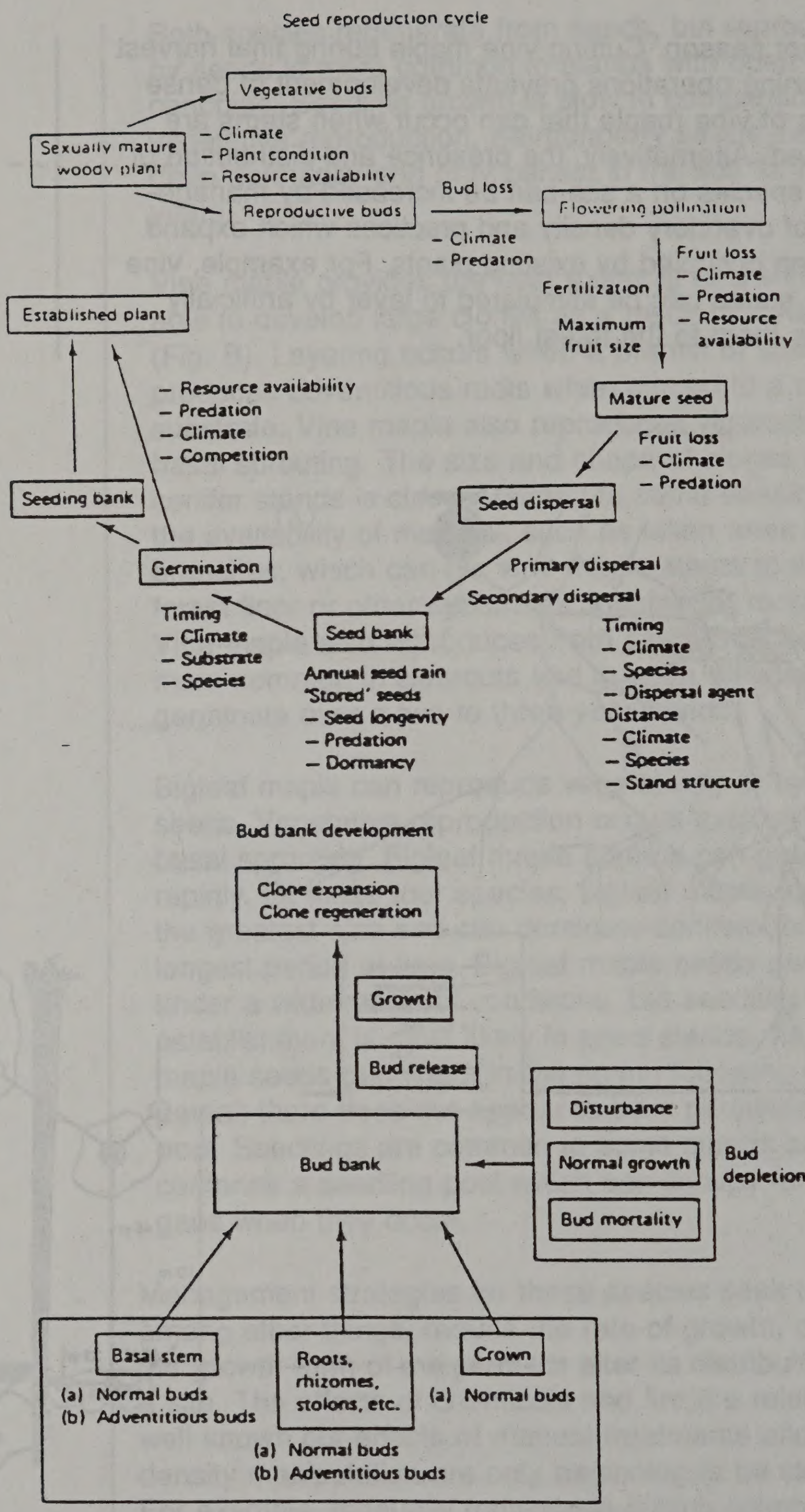


Figure 1. Conceptual models for understanding the components of seed (top) and vegetative (bottom) reproduction.

Silviculture for Enhancing Structural Diversity of Young Forests - A Controlled Experiment and Simulations of Future Stand Development

Gabriel F. Tucker, Stuart R. Johnston, William H. Emmingham, & Steven L. Garman

Within the millions of acres now designated as Habitat Conservation Areas in Western Oregon and Washington are hundreds of thousands of acres of young (0-30 years old) plantations of Douglas-fir. Such dense, nearly-pure plantations generally develop into closed canopy forests and remain in that condition for decades.

Adaptive COPE OSU, PNW Experiment Station, and the Siuslaw National Forest are cooperating on a study to test the hypothesis that commercial thinning and underplanting will hasten development of stand structure favorable to the spotted owl and its prey species. Treatments in the selected 30-year old pre-commercially thinned stands include thinning to normal (100 TPA (trees per acre)), wide (60 TPA), and very wide (30 TPA) spacings and control (250-300 TPA). Underplanting of conifers (Douglas-fir, W. Hemlock, Grand fir, Sitka spruce, W. redcedar, and Pacific yew) and hardwoods (red alder and bigleaf maple) will be tested at all densities. Cost of logging, development of high and low canopy structure, growth and yield of timber, as well as micro-climatic and soil conditions will be monitored. Spacing treatments will be replicated in five acre blocks on several 30 to 50 acre plantations.

Three stand growth models were used to project future conditions. The ORGANON growth analysis projection model (Western Willamette Valley Version) was used to simulate growth of the overstory following the different levels of commercial thinning in these 30-year old pre-commercially thinned stands. Visualizations of overstory development were produced using the TASS (Tree And Stand Simulator) model. The understory, and more long-term stand development, was modeled using Zelig which is a process based model. Data for the model runs was collected from one acre permanent plots located near Mapleton, Oregon, at the first of several sites of this interdisciplinary ecosystem management project. Model output included variation in average tree diameter breast height, total tree height, canopy closure, crown length, and stand density over time. Results show differences for each of these parameters with the exception of mean tree height which varied little over time. One of the most

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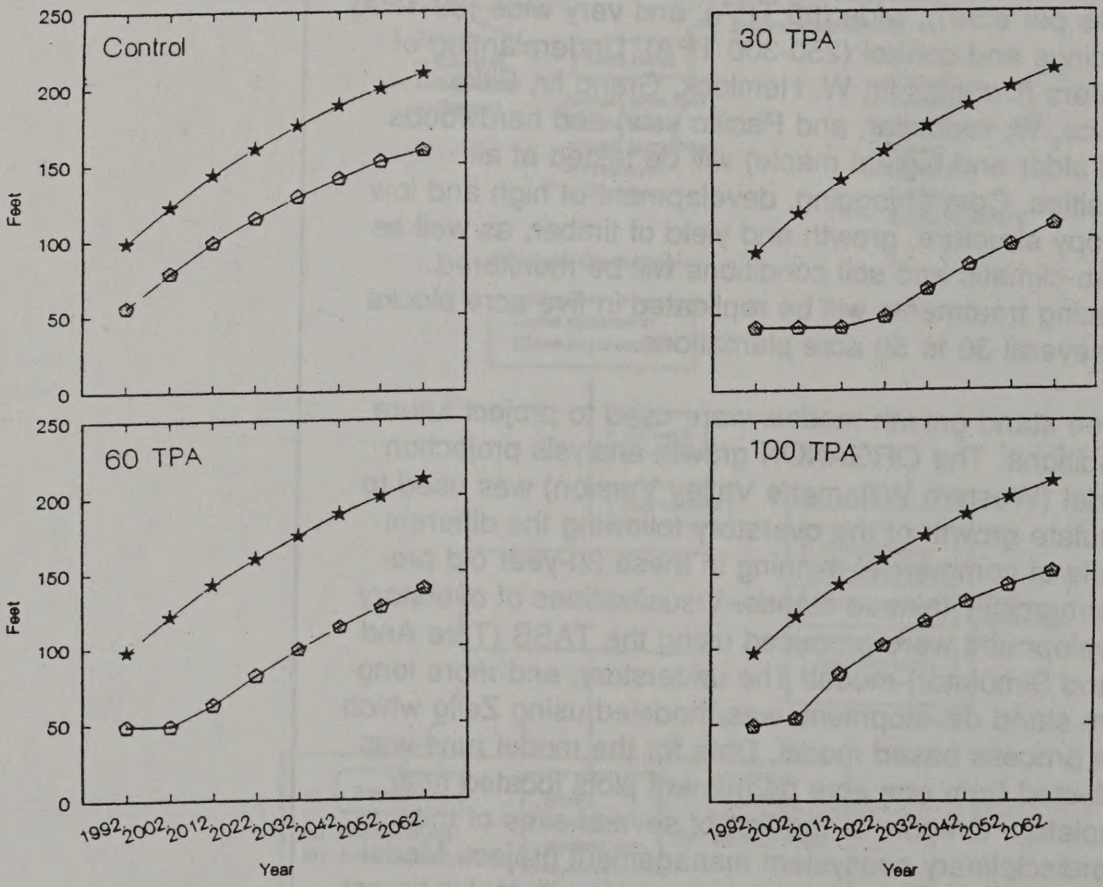
striking differences in structural diversity is shown by the crown profiles generated from ORGANON output (see figure). In the uncut control, the crowns continue to get proportionately smaller with time. This is in contrast to trees in the 30 TPA treatment which show a projected increase in size, at least through the year 2010. Response of the other two treatments is similar to the 30 TPA, but was not as accentuated.

The stand models provide estimates of the impact that such treatments have on development of stand structural diversity. The long-term results of the project will, in turn, be used to refine future modelling efforts to simulate trends in stands of increased structural complexity.



In each of the above graphs, live crown profiles over time are exhibited by the area between the upper plot of total tree height (stars) and the lower plot of height to the base of the live crown (pentagons). Each graph is for a different treatment. Stands were 30 years old when thinned to 30, 60, or 100 TPA (Trees Per Acre). The uncut control was approximately 250 TPA. (by K.G. Maas, 1993)

Responses of Vertebrate Communities to Stand and Landscape Patterns in Natural and Managed Forests in Western Oregon

Andy Hansen

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This paper synthesizes the results of three COPE studies on wildlife habitat relationships to answer two questions: 1) In what ways do habitats and vertebrate communities differ between natural and traditionally-managed stands of similar ages? 2) What are the ecological and economic costs and benefits of creating the habitat features typical of natural forest in managed forests? A study in the Oregon Coast Range found that traditionally-managed plantations supported fewer species and lower bird, mammal, and amphibian abundance than natural, mature forest. The difference between natural and traditionally-managed forest is likely due to the greater habitat complexity in natural forest. Some of these species avoided forest/clearcut edges, achieving peak abundances in forest or clearcut interiors. These data suggest that stand size and edge characteristics influence habitat suitability for some vertebrates.

A second study examined vegetation structure and bird communities across 68 natural and managed stands in the Oregon Cascades that represented a gradient in stand age and structural complexity. Some bird species were found to be associated with each of four stand types: recent clearcuts, harvest units with canopy tree retention, closed-canopy plantations, and natural mature and old-growth forest. Statistical functions were developed for each of 17 bird species relating bird abundance to habitat features. These functions were used in the third study.

Finally, we used a simulation model to evaluate the effects of alternative management strategies on bird communities and wood production. The forest model ZELIG was used to perform a factorial simulation experiment on long-term responses of ecological and economic variables to nine levels of canopy tree retention and four rotation lengths. The results indicated that stand structure under each of the canopy tree retention levels was more similar to the pre-treatment natural forest than following clearcutting. Tree species composition was strongly related to retention level and rotation age. The shade-intolerant, Douglas-fir lost dominance to shade-tolerant species under intermediate retention levels and longer rotations. Wood production

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decreased significantly with increasing retention level and rotation age, with a notable threshold between retention levels of 0 and 5 trees/ha. Net wood products value did not decrease as rapidly with retention level and did not differ much among rotation ages, because of the high value of large logs. Bird species responded individualistically to retention level and rotation age. Some had peak densities under short-rotation clearcutting, but most were associated with structurally-complex, closed canopy forest. Consequently, bird species richness increased significantly with retention level and rotation age.

We concluded that alternative silvicultural strategies strongly influence ecological and economic responses in PNW forests and that efforts are needed to reduce the uncertainty about these effects. Collectively, these three studies provided knowledge on trends and thresholds that can help land managers to choose the silvicultural regimes that best balance their management objectives.

Relationship Between Landscape Structure and Breeding Birds in the Oregon Coast Range

Kevin McGarigal & William C. McComb

Human-caused fragmentation of forests is increasing, yet the consequences of these landscape changes to vertebrate communities are poorly understood. Although bird community response to forest fragmentation caused by agricultural or urban development has been well-studied, we have little understanding of these dynamics in landscapes undergoing intensive forest management, where mature forest islands are separated by younger forest stands of varying ages and are part of a spatially and temporally dynamic forest landscape.

We investigated the relationship between landscape structure and breeding bird abundance patterns in the central Oregon Coast Range. We sampled vegetation and birds in 10 subbasins (250-300 ha) in each of three basins based on the proportion of subbasin in a late-seral forest condition and the spatial pattern of that forest condition within the subbasin. We applied the program FRAGSTATS to generated digital vegetation cover maps to compute a variety of metrics of landscape structure for each subbasin. Using analysis of variance and regression procedures, we quantified the independent effects of habitat area and habitat pattern on several bird species associated with late-seral forest.

Species varied dramatically in the strength and nature of the relationship between abundance and several gradients in habitat area and pattern at the subbasin scale. Relationships between bird abundance and landscape structure were generally weak; landscape structure (composition and pattern) typically explained less than 50% of the variation in each species' abundance among the 30 subbasins. Species' abundances tended to be greatest in heterogenous landscapes; that is, they were associated with the more fragmented distribution of habitat. Only winter wrens showed evidence of association with the least fragmented landscapes. The results are interpreted within the context of a landscape ecological conceptual framework and the limitations of the study are discussed with reference to this framework.

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Coastal Landscape Analysis and Modeling Study (CLAMS)

Thomas A. Spies, Joseph E. Means, K. Norman Johnson, Warren C. Cohen, William C. McComb, Gordon H. Reeves, & Steve Garman

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Our understanding of ecosystems is largely based on studies of small areas for short periods of time. While these studies have advanced our ecological understanding, they have not occurred at the spatial and temporal scale of many ecological processes such as long-term forest succession, population dynamics, disturbance, and environmental and land use change. We typically lack information and understanding of the pattern and processes of mosaics of ecosystems over large areas (10-100,000 acres) over long periods of time (10 to 10,000 years). In addition to our poor understanding of large scale ecosystems, we lack information about how human land use activities affect biological diversity and ecosystem structure and processes. Given that human activities have and are continuing to change the biosphere, it is imperative that we expand our concept of ecosystems to include human land use.

A research project is being designed to provide information about the ecology and management of a provincial (subregional) ecosystem, the Oregon Coast Range (Figure 1). This 5,000,000 acre province is a mosaic of landscapes and watersheds, and is characterized by a highly productive forest ecosystems, distinctive biotic communities, strong aquatic-terrestrial ecosystem linkages, and diverse ownership and forest history/use patterns.

CLAMS is a pioneering research effort whose overall objective is to develop and evaluate concepts and tools that can be used to help science and society understand and visualize the ecological and economic consequences of alternative management strategies at the province level. CLAMS is intended to meet some of the current technical information needs of social partnerships and interagency planning groups (Figure 2), while developing basic scientific information about ecosystems at province level. CLAMS is organized around four major interrelated objectives:

1. Develop a multi-ownership ecological data base using remote sensing, GIS, and ground plots and evaluate approaches for pattern mapping and change detection.

2. Characterize patterns and changes in vegetation and habitat of the Coast Range in relation to environment and land ownership/use.

3. Develop models that can be used to evaluate biological and economic effects of alternative provincial policies and management strategies.

4. Develop an ecosystem dynamics approach to forest management and planning at watershed to provincial scales and evaluate it in terms of wildlife, fish, and economics.

Approaches to meeting these objectives and expected products will be discussed.

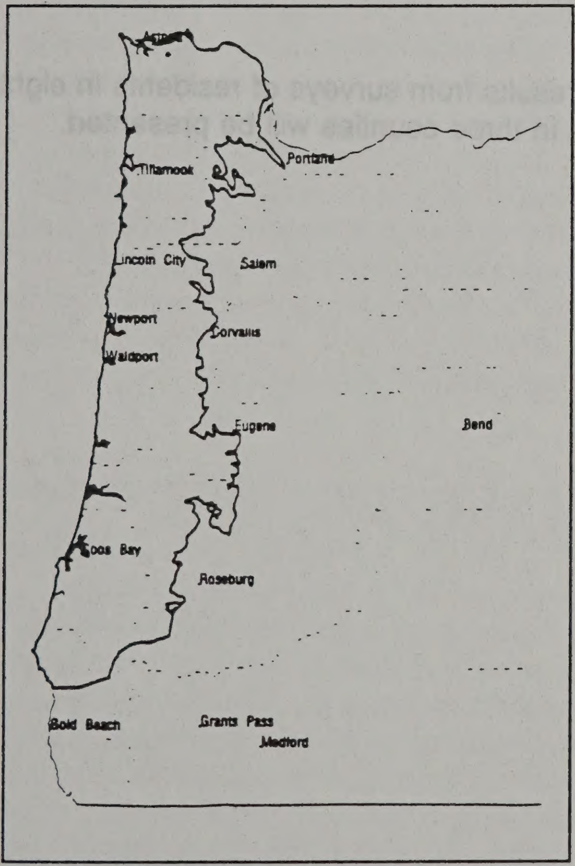

Figure 1. The CLAMS study area.

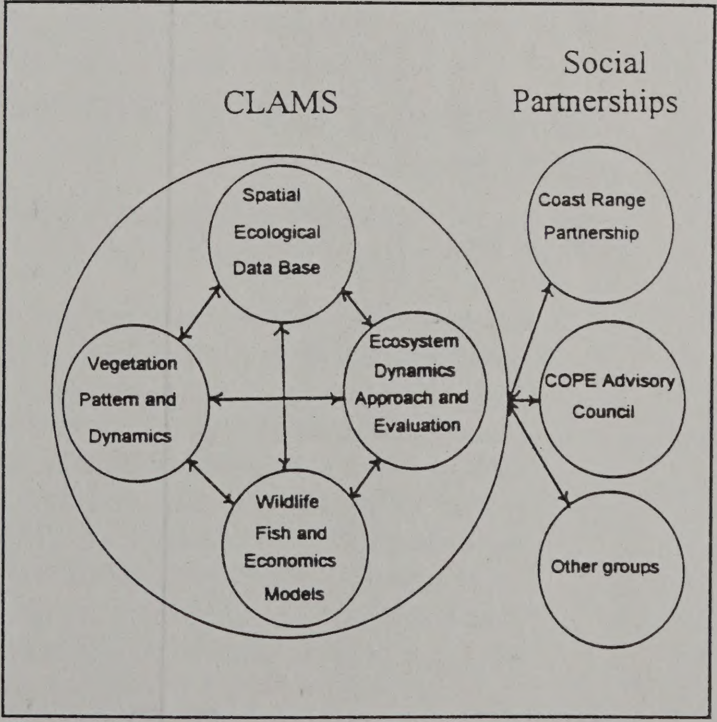
CLAMS
Social Partnerships
Spatial Ecological Data Base
Vegetation Pattern and Dynamics
Ecosystem Dynamics Approach and Evaluation
Wildlife Fish and Economics Models
Coast Range Partnership
COPE Advisory Council
Other groups

Figure 2. Major components of CLAMS study and linkage with interagendy and social partnership efforts.

Management Policies for Increasing Recreation's Contribution to the Economies of Oregon Coast Range Communities

Rebecca L. Johnson & Kreg Lindberg

Notes

Oregon Coast Range counties are currently undergoing a significant transition as the recreation/tourism industry is developed in an effort to diversify local and regional economies. While tourism already plays an important role in these economies, the long-term stability of this industry requires that future planning and management recognize and address tourism's social and ecologic impacts.

Ongoing research sponsored by COPE and Sea Grant focusses on identifying 1) tourism's current economic contribution, 2) opportunities for increasing this contribution, and 3) tourism-related social and ecologic concerns. By identifying social concerns through resident surveys, this research will enable coastal counties and communities to manage negative impacts, thereby sustaining tourism's future economic contribution.

Preliminary results from surveys of residents in eight communities in three counties will be presented.

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Poster Abstracts

Models and Valuation of Forest Management and Anadromous Fish

Susan Alexander

Fish populations and human influences on fish interact in complex and poorly understood ways. The interaction of forest management and fish populations has become a topic of debate. Some preliminary work has been done on riparian area resources, and some assessments of the economics of forest management-fish interactions have been done. More work needs to be done on riparian resource valuation.

One way to develop information on economic impacts of forestry-fishery interactions is to use models of habitat, forest management, and economics, and tie together the results. This study will use the landslide delivery index and the habitat condition index developed by Ricks and Chen (1990) for the Elk River drainage basin in southwestern Oregon to illustrate possible effects of sediment on fish populations. A simple repeated discrete-choice random utility model will be developed and used with data from the latest Oregon angler survey to assess marginal values for anadromous fish. The values of fish obtained from two management regimes for the Elk River will be compared. Perhaps no significant difference in value will be found because of the variance in the models. Economic concepts of value and how different methods of valuation affect prices assigned to non-market goods will be discussed.

Regeneration of Riparian Areas: Interaction of Site and Vegetation Factors

Samuel Chan, Don Minore, Peyton Owston, David Hibbs & Peter Giordano

Regeneration of conifers in riparian areas is critical to the development and maintenance of diversity. Diversity of riparian areas is foremost addressed at the watershed level. Opportunities to develop and restore forest complexity and diversity in riparian areas occurs, for practical reasons, at the stand level. Changes in natural disturbance patterns, impacts from homesteading, grazing, historical logging practices and lack of woody substrate for natural conifer regeneration along streams have resulted in the development of red alder/salmonberry plant communities in many riparian areas of the Oregon Coast Range. The resulting homogeneous alder/salmonberry dominated stream systems often exclude conifer regeneration.

A current study on red alder dominated riparian sites in the Oregon Coast Range is assessing the effect of different levels of overstory and understory retention on the response of six (Douglas-fir, grand fir, red alder, Sitka spruce, western hemlock, and western redcedar) planted tree species to created growing conditions. Microsite variability is high in riparian areas. Soil textures, moisture availability, and depth to water table can vary substantially within meters. Light availability through the undisturbed overstory is usually less than 10% of open conditions. Gaps in the overstory are occupied in the understory by herbs and woody shrubs. Conifer survival after 3 years ranged from 57% to 92%. Except for western red cedar, survival of underplanted trees was generally lower under complete overstory retention. Survival under partial (to attain exposure of 60% of full sunlight) and no overstory canopy retention was about equal. Though tree survival was high across the range of overstory levels, growth was lower when the overstory was left intact. Removal of the overstory stimulated understory shrub and herb development. Understory shrub removal increased the growth of all species with the exception of red alder. Intensive removal of the understory shrubs stimulated herbaceous growth.

The physical diversity of riparian areas and the dynamic response of vegetation to changes in the riparian environment dictate that we avoid blanket regeneration prescriptions across a landscape. Regeneration of trees in riparian areas will most likely succeed when site and vegetation factors are considered and matched to management objectives.

Asymbiotic Biological Nitrogen Fixation Associated With Coarse Woody Residues of Oregon Coastal Forests

Ralph Crawford and Ching Y. Li

Coarse woody residues are conspicuous features of the forest floor in coastal Oregon forests. They provide habitats for plants, animals, and a diversity of microorganisms. Live plants are partially or completely rooted in the woody residues. Nitrogen fixation has been detected in coarse woody residues. This study provides baseline information on nitrogenase activities (nitrogen fixation) and populations of nitrogen-fixing organisms in root-colonized and noncolonized woody residues on forest and clearcut sites. Coarse woody residues of decay classes IV-V were sampled at three sites of Douglas-fir stands having varying amounts of understory vegetation. The woody residues at lower elevation sites near the coast had the least nitrogen fixation activity and N2-fixing bacterial populations. Plant colonized- and noncolonized-woody residues had significantly higher nitrogenase activity than the adjacent soils, but the activity between the colonized and the noncolonized woody residues did not differ significantly. Presumably, the abundant carbon source required for nitrogenase activity was available in the noncolonized woody residues. Nitrogen-fixing Azospirillum sp. was detected in all woody residues and was able to utilize wood lignin as a carbon source for nitrogenase activity.

Coquille River Fisheries and Timber Coalition

Ralph Duddles & Paul Heikkila

Fish habitat in the Coquille River drainage has been degraded by man's activities over the past 150 years. Fish populations are at historic lows. Coasta Coho runs may ultimately be listed as threatened species if present declines are not reversed. User groups such as timber, agriculture, and commercial and sport fisheries are often at odds as to how to do this. These groups realize that they need to cooperate to help reverse these trends and preclude listings under the THREATENED and ENDANGERED SPECIES ACT. Such listings would disrupt and devastate the local resource based economy.

COALITION OBJECTIVES: To provide a mechanism to actively manage riparian areas and stream habitat to achieve future conditions that will protect and enhance fish productions. To achieve consensus among key user groups, policy makers and regulators.

METHODS: OSU Extension played a key role in facilitating coalition building. Major role players have been brought together for open dialog to seek common ground. They include:

- Commercial Fisheries' Interests
- Salmon Trout Enhancement Program (STEP)
- Timber and Agriculture Interests
- Woodland Owners
- County Government
- Resource Agencies

The Influence of Commercial Thinning on Wildlife Populations and Stand Structure

John P. Hayes, William H. Emmingham, Robert G. Anthony,
Nobuya Suzuki, & Michael Adam

Commercial thinning has been proposed as a means to meet various resource needs in Coast Range forests. However, fundamental questions concerning the response of wildlife populations in young stands to thinning activities and snag creation remain unanswered. Adaptive COPE has instituted a new study to examine the influence of commercial thinning intensity and installation of snags on wildlife populations in managed plantations. The study will involve subjecting relatively large treatment areas (at least 70 acres) to different thinning intensities and densities of created snags. Each treatment will be replicated four times on the Tillamook State Forest and adjacent lands owned by the Stimson Lumber Company. Data on the response of bird, amphibian, and mammal populations will be monitored over time. In addition, responses of vegetation will also be examined, from the perspectives of wildlife habitat, stand development, and natural regeneration of conifers. Pre-treatment data collection will begin this spring and the stands will be thinned this summer and fall. Post-treatment data collection will continue annually through the end of the COPE Program.

Hardwood Silviculture Cooperative

David Hibbs, & Karl Buermeyer

Interest in managing hardwood species to ensure future supplies of hardwood lumber, for species diversity, and as an alternative to conifers in disease pockets, is increasing in the Pacific Northwest. In 1991, the hardwood industry in Washington and Oregon employed over 7000 people, providing an annual income of just under $200 million.

The Hardwood Silviculture Cooperative (HSC), based at the Oregon State University College of Forestry, conducts high priority research on hardwood species and mixed hardwood/conifer stands in the Pacific Northwest. The goals of the cooperative are to:

* develop guidelines for stand establishment and management

* synthesize and disseminate information on hardwood resources

* encourage and cooperate in fundamental research on the biology of hardwood species as a component of forest systems

* facilitate integration and cooperation among Pacific Northwest organizations concerned with the hardwood resource and its management

Participants in the cooperative include members of industry, public agencies, and educational institutions. Priorities for cooperative activities are set by members and are carried out by cooperators and Oregon State University staff. General activities of the cooperative include:

1) silvicultural research on hardwood species

2) publications

3) information and technology transfer, through written materials, workshops, and field tours

Some specific examples include working with forest nurseries to develop quality alder growing stock, helping land owners and managers identify appropriate sites and treatments for managing hardwoods, and the publication of guides for the management of hardwood species.

The two main research priorities at the present time are the Red Alder Stand Management Study, and the Alder Wood Quality Study.

The Red Alder Stand Management Study was initiated in 1988. Its goal is to develop an information base with which to model growth and yield in red alder in managed stands, and the effect of various planting and thinning regimes on growth, yield and wood quality. This will be accomplished through manipulation of a series of natural stands (Type 1 installations) and plantations (Type 2 installations) over a range of physiographic regions and site qualities. In addition, mixtures of red alder and Douglas-fir will be planted (Type 3 installations, nine are planned) to examine the interaction of these two species growing together.

The Alder Wood Quality Study is being conducted in two parts. The Lumber Recovery Study was completed in 1992. This was a cooperative study with the PNW Timber Quality Project in which the HSC supplemented their log-to-lumber and grade recovery project with tree and stand data. This study found that the dollar value from alder trees was from high-grade lumber, primarily in the butt log (the first three meters).

The second part of the study, tree growth and self-pruning as a function of spacing and thinning, has begun this year. Three objectives for the current effort are to:

- Develop equations that describe branch growth, branch mortality, and crown lift as a function of spacing
- Quantify the effects of spacing on stem taper
- Examine the effects of thinning on branch, height, and bole diameter (taper) development

Data is being collected from research plots with a well known history of spacing.

Establishment and Regeneration of Salmonberry and Salal in the Coast Range Forests of Oregon

David W. Huffman

We examined seedling establishment, clone architecture, and clone population dynamics of salmonberry (Rubus spectabilis Pursh.) and salal (Gaultheria shallon Pursh.) in the Coast Range forests of Oregon.

Seedling establishment of both species was affected by overstory density. Seedling survival was greatest in thinned stands whereas neither species survived in unthinned stands of Douglas-fir (Pseudotsuga menziesii (Mirb.) Franco). Salal seedling establishment was greater on rotten logs than on other substrates.

Clones and clone populations were affected by overstory density and species composition. The largest salmonberry clones, systems of below-ground rhizomes and aerial stems, were found in red alder (Alnus rubra Borg) stands. Salal clones were largest in thinned stands of Douglas-fir. Rhizome and aerial stem densities were greatest in clearcuts whereas dense overstories greatly reduced the size and vigor of clones. Both species appear to maintain a persistent cover and an uneven-age aerial stem population structure by seasonal generation of new stems. Management implications are discussed.

Plans and Progress Towards Developing an Extensive Ecosystem Approach to Management of the Oregon Coast Range

Joseph E. Means, Thomas A. Spies, Warren Cohen, Norm Johnson, & Scott Splean

This study examines the Oregon Coast Range as a subregional ecosystem that includes public and private policies, landscape ecosystems and local economies. The study is designed to obtain a better understanding of the effects of land-use and environment on patterns and dynamics of vegetation, wildlife habitat, fish habitat and local economies. Scenarios of different management policies will be designed with disturbance (logging) frequencies and patterns and types of surviving vegetation that span the range of past disturbances, primarily fire. Classification of a Thematic Mapper image shows different patterns of vegetation cover for federal, state and private land.

We plan to build models that (1) relate changes in land use and decisions to cut trees to type of owner, landscape location and economic climate, (2) predict vegetation succession and tree growth for different Coast Range environments and (3) relate habitat quality for selected wildlife species and stream habitat to patterns of vegetation and land use. We then plan to look at sensitivity of landscape patterns, wildlife habitat, stream habitat and local economies to different disturbance regimes in policy scenarios.

Forest Environment and Understory Vegetation Before and After Commercial Thinning

Don Minore, Sam Chan, Pete Owston, Howard Weatherly, Dan Mikowski, Chuck Acton, and Valerie Banner

Dense, young, even-aged stands of Douglas-fir lack the multi-storied structure and biological diversity typical of old-growth forests. In cooperation with Oregon State University, three commercial-thinning treatments and an unthinned control are being established at three coastal Oregon sites to see if structural development can be accelerated through silvicultural manipulation. The thinning treatments were applied in 1992 at one of those sites near Mapleton, Oregon, where both preharvest and initial postharvest measurements have been completed.

The unthinned stands had 280 TPA (trees per acre) and understory light levels of 2 to 3% of full sunlight. Thinning to 100 TPA increased available light to 20%, and understories of the stand thinned to 30 TPA had 63% of full sunlight. Thinning did not affect the amounts of exposed soil or large, woody debris; but it substantially increased the depth, cover, and volume of fine slash (<5 cm in diameter).

The occurrence, abundance, and height of each of the 12 shrub and 20 herb species present were measured before and after thinning. Logging damage reduced shrub heights, shrub cover, and the cover of most herbs in the thinned stands. Several new herb species began to appear in 1993.

Equal numbers of 2-year-old Douglas-fir and western hemlock seedlings were planted the first winter after logging in half of the areas studied in each stand to evaluate the effect of understory trees on structural development. First-year survival exceeded 90% for both species in each of the thinned stands. Survival was 60% for western hemlock and zero for Douglas-fir in the unthinned control.

Sound Application of Fire on Oregon Coastal Lands

Roger D. Ottmar

Prescribed fire is a valuable tool in the management of natural resources in the coastal areas of Oregon. Prescribed fire can be used to improve reforestation, reduce fire hazard, and improve rangeland characteristics. It has also been used to perpetuate certain fire-evolved ecosystems. Unfortunately, smoke generated from controlled burning is unpopular with the public and is contrary to current State and Federal laws. Although smoke emissions from prescribed burning in Oregon have decreased by 30 to 50 percent in the last decade (Sandberg and Dost 1990), much of the public considers any smoke "too much smoke." They are concerned with both the visibility impairment associated with smoke and the possibility of subsequent health hazards. The Clean Air Act mandates that all forest management activities utilize the best available control technology to minimize pollution.

The Fire and Environmental Research Applications Group (FERA), a research, development, and application team in Seattle, has completed three computer software products to assist land managers in applying the best available control technology for smoke during prescribed fires on coastal Oregon lands. The products are (1) CONSUME, an interactive, user-friendly model for fire managers to predict fuel consumption; (2)SMSINFO, a Paradox-based processing model for State agencies to analyze records from annual prescribed fire accomplishments; and (3) EPM, an interactive model that predicts fuel consumption and emissions from individual prescribed burns at time intervals, suitable for use with dispersion models. These software packages are important tools for planning and managing prescribed fires to meet site objectives and smoke management requirements.

The FERA Group is also measuring firefighters' exposure to smoke during prescribed burn operations in the coastal Oregon area and other areas within Oregon and Washington. This assessment will be used to develop a management strategy which will reduce the risk that firefighters will exceed smoke exposure limits.

Conceptual Framework for a Forest Regeneration Expert System

Lauri J. Shainsky & Steven A. Knowe

This poster describes the conceptual framework for a decision support system (DSS) designed to assist land managers in formulating site-specific prescriptions that ensure successful forest regeneration in the Coast Range of Oregon. The DSS utilizes the latest information on factors influencing regeneration of key conifer species to guide management decisions in the early stages of forest succession. A major component of the DSS is the simulation of autecological processes related to the invasion and growth of potential competing vegetation and their effects on conifers in the first five years after planting. Site characteristics, plant population biology, preharvest conditions, and harvest intensity are used to predict the consequent growth and survival of target crop species under different management scenarios. Land managers can compare consequences of regeneration practices by linking early stand simulations with conventional growth and yield models. The decision support system will provide schedules for harvesting operations, site preparation, planting or natural regeneration, and early stand treatments. In addition, the DDS will provide a focal point for collecting and synthesizing future information on the regeneration process and serve as a valuable tool for testing hypotheses on succession and management of Oregon's Coast Range forests.

Buffer Strip Dynamics in the Western Oregon Cascades

Kim Sherwood & Dr. H.A. Froehlich

Although buffer strips have long been used as a protection tool when logging near streams, long-term studies investigating buffer strip dynamics are rare. During the late 1970s, Ivars Steinblums inventoried 40 buffer strips 1 to 15 years old in the western Oregon Cascades.

During the summer of 1990, 16 of the buffer strips were reinventoried to assess overstory changes. Sample areas ranged from 400 to 700 feet in length and 20 to 200 feet in width. Conifers >10 inches DBH were tallied by species and diameter. Conifer regeneration was sampled at 100-foot intervals (stream distance) across the width of the buffer strip.

Average combined conifer (western hemlock, western redcedar, and Douglas-fir) densities of these late successional buffer strips increased from 54 to 59 trees/acre since the earlier study; average combined conifer basal area decreased from 299 to 263 ft 2/acre since the original study. Summarizing overstory dynamics of the sites:

1. Most buffers are making periodic, rather than episodic contributions of large woody debris.
2. Episodic blowdown from the January 1990 storms was restricted to two isolated locales.
3. Comparisons on many sites reveal a substantial increase in conifer density, particularly western hemlock, in the smaller size classes.

Conifer regeneration data suggest these buffer strips may be sufficiently stocked to maintain conifers over time. Variability was high, but average density of saplings ranged from nearly 200 to 3600 trees per acre. Regeneration was dominated by western hemlock, but western redcedar and Douglas-fir also contributed on many sites.

Active Riparian Area Management: Effects on Forest Resources

Arne Skaugset, Elizabeth Dent, Doug Bateman, Mike Newton, Jenny Walsh, Elizabeth Cole, Loren Kellogg, Stan Pilkerton, Mike Miller, & B. Stringham

This is a large, integrated, manipulative project which consists of three studies which will be carried out at an operational scale and include both riparian silviculture and stream enhancement as a part of timber harvesting. The project consists of three harvest units located adjacent to perennial, anadromous fish-bearing streams which have hardwood and shrub dominated riparian areas and are debris-poor. During timber harvesting, different sized openings will be created in the riparian areas and large woody debris for debris accumulations will be placed in the streams within the riparian openings using the yarding equipment. Different species and stocktypes of conifers will also be planted in the riparian openings.

The riparian silviculture study will investigate the establishment and growth of conifer seedlings in riparian areas. The stream enhancement study will investigate the effect of placing large woody debris in streams within riparian openings on streambank disturbance, stream temperature, and fish habitat. A final study is the logging engineering research. This study will investigate the productivity and costs of harvesting riparian openings and placing large woody debris in streams using harvesting equipment.

Some preliminary results are available. They include the operational costs of placing large woody debris in two of the three treatment streams and the amounts of large woody debris that were added to each stream.

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Affiliations

Acton, Chuck / USDA Forest Service, PNW Research Station, Corvallis, OR

Adam, Michael / Adaptive COPE, 2030 S. Marine Science Drive, Newport, OR 97365

Adams, Paul W. / OSU Forest Engineering Dept., Corvallis, OR 97331

Alexander, Susan / USDA Forest Service, Forestry Sciences Lab 148, 3200 SW Jefferson Way, Corvallis, OR 97331

Anthony, Robert G. / OR Cooperative Wildlife Research Unit, Dept. of Fisheries and Wildlife, OR State University, Corvallis, OR 97331-3801

Banner, Valerie / USDA Forest Service, PNW Research Station, Corvallis, OR 97331

Bateman, Douglas / Adaptive COPE & OSU Forest Engineering Dept., 2030 S. Marine Science Drive, Newport, OR 97365

Beschta, Robert L. / OSU Forest Engineering Dept. Peavy Hall 231, Corvallis, OR 97331

Brown, George W. / Dean OSU College of Forestry & Director Forest Research Lab, Peavy Hall 150D, Corvallis, OR 97331

Brown, Perry / Assoc. Dean, College of Forestry, OR State University, Corvallis, OR 97331

Buermeyer, Karl / OSU Forest Science Dept., Corvallis, OR 97331

Burnett, Kelly / USDA Forest Service, Forest Science Dept., Corvallis, OR 97331

Chan, Samuel / USDA Forest Service, PNW Research Station, Corvallis, OR 97331

Cole, Elizabeth / OSU Forest Science Dept., Corvallis, OR 97331

Connolly, Patrick J. / OSU, Dept. of Fisheries and Wildlife, Nash 104, Corvallis, OR 97331

Crawford, Ralph / USDA Forest Service, PNW Research Station, Forestry Sciences Laboratory, 3200 SW Jefferson Way, Corvallis, OR 97331

Dent, Elizabeth / Adaptive COPE & OSU Forest Engineering Dept., 2030 S. Marine Science Drive, Newport, OR 97365

Duddles, Ralph / OSU Extension Service Forestry, 290 N. Central, Coquille, OR

Emmingham, William H. / OSU Extension Forestry & Adaptive COPE, Peavy Hall 017, Corvallis, OR 97331

Fieth, Steve / OSU Dept. of Fisheries & Wildlife, Corvallis, OR 97331

Froehlich, Dr. H.A. / Hydrologist, OSU Forest Engineering Dept., Corvallis, OR 97331

Furnish, Jim / Acting Supervisor, Siuslaw National Forest, Corvallis, OR

Garman, Steven L. / OSU Forest Science Dept., Corvallis, OR 97331

Giordano, Peter / OSU Forest Science Dept., Corvallis, OR 97331

Gomez, Douglas M. / OR Cooperative Wildlife Research Unit, Dept. of Fisheries and Wildlife, OSU, Corvallis, OR 97331-3801

Gregory, Stan / OSU Dept. of Fisheries & Wildlife, Corvallis, OR 97331

Hansen, Andrew / Biology Dept., 310 Lewis Hall, Montana State University, Bozeman, Montana 59717

Hansen, Bruce / USDA Forest Service, 3200 SW Jefferson Way, Corvallis, OR 97331

Harrington, C. / USDA Forest Service, PNW Research Station, 3625 93rd Ave. S.W., Olympia, WA 98512

Hayes, John P. / Adaptive COPE, & OSU Forest Science Dept. 2030 S. Marine Scinece Drive, Newport, OR 97365

Heikkila, Paul / OSU Extension Service Fisheries/Sea Grant, 290 N. Central, Coquile, OR

Hibbs, David / OSU Forest Science Dept., Corvallis, OR 97331

Hobbs, Stephen P. / COPE Program & USDA Forest Service, 3200 SW Jefferson Way, Corvallis, OR 97331

Hospodarsky, Denver / School of Forestry, Northern Arizona University

Hounihan, Patrick T. / Adaptive COPE & OSU Forest Engineering, 2030 S. Marine Science Drive, Newport, OR 97365

Huffman, David W. / OSU Dept. Forest Resources, Corvallis, OR 97331

Johnson, Norm / OSU College of Forestry, Corvallis, OR 97331

Johnson, Rebecca L. / OSU Forest Resources Dept., Corvallis, OR 97331

Johnston, Stuart R. / USDA Forest Service, Mapleton, OR

Kacynski, Vic / Fisheries Biologist and private consultant

Kellogg, Loren / OSU Forest Engineering Dept., Corvallis, OR 97331

Knowe, Steven A. / OSU Forest Science Dept., Corvallis, OR 97331

Kramer, Mari J. / USDA Forest Service, Corvallis OR 97331

Li, Ching Y. / USDA Forest Service, PNW Research Station, Forestry Sciences Laboratory, 3200 SW Jefferson Way, Corvallis, OR 97331

Lindberg, Kreg / OSU Forest Resources Dept., Corvallis, OR 97331

Maas, Kathleen / Adaptive COPE, & OSU Forest Science Dept., 2030 S. Marine Science Drive, Newport, OR 97331

McComb, William C. / OSU Forest Science Dept., Corvallis, OR 97331

Mcgarigal, Kevin / OSU Forest Science Dept., Corvallis, OR 97331

Means, Joe / USDA Forest Service, PNW Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331

Merola, Robert B. / USDA Forest Service, Corvallis, OR 97331

Mikowski, Dan / USDA Forest Service, PNW Research Station, Corvallis, OR 97331

Miller, Mike / OSU Forest Engineering Dept., Corvallis, OR 97331

Minore, Don / USDA Forest Service, PNW Research Station, Corvallis, OR 97331

Nelson, Earl E. / USDA Forest Service, PNW Research Station, 3200 SW Jefferson Way, Corvallis, OR, 97331

Newton, Mike / OSU Forest Science Dept., Corvallis, OR 97331

Noss, Reed / Editor of Conservation Biology & OSU Dept. of Fisheries and Wildlife, Corvallis, OR 97331

O'Dea, Mary / OSU Forest Science Dept., Corvallis, OR 97331

Olson, Deanna / USDA Forest Service, 3200 SW Jefferson Way, Corvallis, OR 97331

Ottmar, Roger D. / Seattle Forestry Science Laboratory, PNW Research Station, Seattle, WA

Owston, Peyton / USDA Forest Service, PNW Research Station, Corvallis, OR 97331

Pabst, Rob / OSU Forest Resources Dept., Corvallis, OR 97331

Pilkerton, Stan / OSU Forest Engineering Dept., Corvallis, OR 97331

Poage, Nathan / PNW Research Station, OSU, Corvallis, OR 97331

Reiter, Maryann L. / OSU Forest Enginering Dept., Corvallis, OR 97331

Schwartz, John / OSU Fisheries & Wildlife Dept., Corvallis, OR 97331

Shainsky, Lauri J. / USDA Forest Service, PNW Research Station, Portland, OR

Sherwood, Kim / Hydrologic Technician, B.L.M., Wenatchee, WA

Shipley, Jack / Applegate Partnership, Grants Pass, OR 97527

Skaugset, Arne / Adaptive COPE & OSU Forest Engineering Dept., 2030 S. Marine Science Drive, Newport, OR 97365

Smith, Clint / Oregon Dept. of Forestry, 2600 State St., Salem, OR 97310

Spies, Tom / USDA Forest Service, 3200 SW Jefferson Way, Corvallis, OR 97331

Splean, Scott / OSU College of Forestry, Corvallis, OR 97331

Starker, Bart / Executive Vice-president, Starker Forests,

Stein, William I. / USDA Forest Service, PNW Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331

Stringham, B. / OSU Forest Engineering Dept., Corvallis, OR 97331

Suzuki, Nobuya / OSU Forest Science Dept. & Adaptive COPE, Corvallis, OR 97331

Tappeiner, John / OSU Forest Resources Dept., Corvallis, OR 97331

Thies, Walter G. / USDA Forest Service, PNW Research Station, 3200 SW Jefferson Way, Corvallis, OR, 97331

Tucker, Gabriel F. / OSU Forest Resources Dept., Corvallis, OR 97331

Walsh, Jennifer / OSU Forest Science Dept., Corvallis, OR 97331

Weatherly, Howard / USDA Forest Service, PNW Research Station, Corvallis, OR 97331

Zasada, John / USDA Forest Service, North Central Forest Experiment Staion, 5985 Highway K, Rhinelander, WI 54501

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